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A PROBLEM THAT BEGS PERMANENT SOLUTION

SHORTLY the time is coming when we must decide which of the gains of recent years are to be permanent, and which of the losses are to be written off the books as sorry pay for past mistakes. At least one such decision must be made by the chemical profession. Are we to forget all that we have learned since 1930 about handling the most human of our professional problems—unemployment and relief? As the business situation gradually improves and chemical jobs again become available in larger number, will we throw into the discard the temporary machinery that was hastily set up in the emergency? Not if we are wise. On the contrary, we will strengthen and preserve it for permanent service to the profession.

Evidently chemical jobs were too easily obtained in pre-depression years. As a result there has grown up no adequate means for coordinating available personnel and opportunities for professional work. It is true that the Chemists' Club in New York has had an employment bureau that has proved useful, but obviously inadequate to serve the entire profession on a national scale. In the emergency, a number of aggressive local groups have also contributed notable service, but nowhere at the present time is there any adequate national clearing house in which, without sacrifice of professional dignity, the chemist or chemical engineer may register with some assurance that his name will be brought to the attention of a large number of inquirers when they want new men. This is a liability which handicaps industry as well as individuals. It could be converted into a great asset if the entire profession would get behind a plan to establish and maintain an adequate employment bureau.

Thought must also be given to the related problem of relief for those less fortunate members of our profession who in times of stress have had to be cared for by public charity or by the volunteer efforts of individuals or local groups. Such a form of relief should not be a volunteer matter. It should be an organized plan, properly supported and staffed, with the overhead carried by the profession as a whole. The cost would be comparatively little—a few cents a week if spread over the entire chemical population. The gain would be a considerable strengthening of the profession in the public esteem and, more important, within our own ranks where professional esteem and solidarity are sadly lacking. We can well afford to make this unselfish start toward the greater goal of professional recognition.

May we suggest that during these summer months those in charge of our technical societies and professional groups—local as well as national—should give some thought to the possibilities of a permanent solution for these problems of unemployment and relief? When the national meetings are held in the Fall, someone should be ready with a program of cooperative effort worthy of the support of the entire chemical profession. Is the new Chemical Council, proposed by Colonel Bogert at St. Petersburg, the proper agency to tackle this problem? Or is the answer to be found in coordinating and broadening the functions of existing organizations? In any event, free discussion should precede definite action by the profession before another winter sets in.

EDITORIALS

Four Out of Five For Permanent Codes

THAT THE CODES are proving beneficial, at least in the Eastern States, is indicated by the canvass recently conducted by the New England Council. More than 80 per cent of the industrialists replying to a questionnaire expressed the opinion that some form of business code is permanently desirable or essential either with or without government sanction or supervision. In view of the fact that this note of approval comes from conservative old New England, it may well be assumed that industry as a whole is not chafing unduly under the present degree of regimentation.

More than 850 manufacturers, operating under 125 codes and employing 240,000 workers, responded to the inquiry conducted in June by the Industrial Committee of the Council. Each manufacturer reported his individual experience in operating his plant under the codes. Forty-six per cent reported that their codes have proved helpful, 40 per cent saw no effect, and 8 per cent reported that they were actually harmful in failing to reduce and relieve unemployment. Only 20 per cent of the 822 replying to the question of the advisability of some form of permanent codification answered in the negative. Forty-three per cent desire a code with governmental sanction or supervision, and another 35 per cent desire a code but without governmental supervision. Two per cent answered "desirable under either situation." Of the 822 manufacturers, 18 per cent are large units, 45 per cent medium sized, and 37 per cent small units in their respective industries.

It is hoped that the Council will continue this interesting investigation so that it may ascertain whether the opinions regarding the codes differ within the individual industry or whether all of the opposition is confined to a few industries.

A "Professional" Defined at Last

BEGINNING back in the early days of the President's Re-employment Agreement, which specifically exempted "professionals," and continuing through the hectic struggles in opposition to that proposed code for commercial research and testing laboratories, the NRA has lacked an adequate definition of this muchly disputed term. Now, of all places where one would least expect to find it, a fairly comprehensive definition bobs up in an official ruling under the code for retail trade. This defines as a professional "a person whose work is: (1) Predominantly intellectual or mental in character as opposed to purely physical work or work involving the application of manual, mechanical, physical or operative technique or skills, and (2) based upon educational training in a specially organized body of knowledge as distinguished from training of a manual, mechanical, or operatively technical type, or the performance of routine mental processes in accordance with a previously indicated or standardized formula, plan or procedure, and (3) of a nature that is creative and cannot be carried on by anyone not having a similar training or qualifications without losing its unique characteristics."

Under an official interpretation of this definition, only the following can be properly classified as professionals: Chemists, physicists, dentists, physicians and surgeons, registered nurses, chiropodists, pharmacists, optometrists, architects, artists and creative decorators, training directors whose entire time is devoted to education or training, research technicians, statisticians and engineers (who hold degrees from qualified institutions of higher learning).

Apparently there's hope for NRA after all!

Significant Anniversaries

TWENTY-FIVE YEARS seems like a long time to our confreres in the book publishing business whose birthday party it was our privilege to attend a few days ago. It is true that that span of years covers a most significant history in the building of scientific and engineering literature. When the book departments of the Hill and the McGraw publishing companies joined forces on July 1, 1909, they not only paved the way for the later merger of their parent companies, but they laid a foundation for many texts and reference works that were to have an important part in shaping the development of chemistry and chemical engineering.

Thirty years is more important to another family in the chemical engineering community. In 1904 a young engineer, ten years out of an Eastern college, was having his troubles out in the Black Hills of South Dakota. They were not the troubles of the tenderfoot in the mining camp, but rather those of a youthful entrepreneur whose investment of brains in new technology was all that kept the sheriff from the door of his remodeled cyanide mill. In designing it to treat the gold ore of the nearby Buxton and Bonanza mines, he had incorporated a number of unusual and untried methods. In it, for example, was the first belt elevator for elevating cyanide solutions, the first Chilean mill to be used in the Hills for cyaniding, the first vacuum leaf filter to operate successfully, and the first inside overflow launders on the leaching tanks. But in it too, were all the difficulties of faulty classification inherent in the mills of that day. A forced shut-down gave the young engineer his opportunity. He boldly tackled the classification problem and after a few weeks of small scale experimenting, he designed and built the first commercial size mechanical classifier in July 1904. It ran successfully and continuously in "converting a monthly deficit into an annual profit." The fame of the mill spread and so did that of its youthful inventor, John Van Nostrand Dorr. His invention of the classifier in 1904, followed by the Dorr thickener in 1906, countercurrent decantation in 1910 and the agitator in 1912 paved the way for the many

related developments which the Dorr Company has successfully translated from metallurgical engineering into the then unrelated fields of chemical and sanitary engineering.

Fifty years takes us further back into the horsecar days, and significantly enough it was as a clerk in a carwheel foundry in Detroit that John Hill Whiting had begun his business career. By 1884 he had risen to superintendent and had developed and patented some significant improvements in the foundry art. He was then ready to launch his own business which ten years later was moved to Harvey, Illinois and became the basis for the great development that now embraces such a wide variety of railroad and process machinery. Significantly, three generations now participate in the active direction of the Whiting Corporation. One of the reasons that its efficient president, General Tom S. Hammond, has been able to give such patriotic service to NRA is because Mr. Whiting's grandson, Stevens H. Hammond, is assistant to the president.

Later in the year, still another golden anniversary is to be celebrated in the chemical equipment field. A half century ago the invention by Pfaudler of the first glass lined tank formed the basis for an important industry. What this has meant to the chemical engineer is not always appreciated until one realizes the number of industries, the world over, that have been able to advance from laboratory to plant scale operation, only because glass lined equipment was available to fill the need. And quite appropriately, the Pfaudler Company celebrates its fiftieth birthday by opening a British factory at Leven, in Fifeshire, Scotland, thus linking America again with Europe where since 1907 another subsidiary in Baden, Germany, has been supplying this equipment to old world industries.

Chem. & Met. is proud to have spent so many of its own 32 years in such distinguished company. To all we extend our congratulations and the reminder of Messrs. du Pont, Kalbfleish, et al., that the first hundred years are the hardest.

Oligodynamic Silver

NOT EXACTLY new except in current interest and American application is an interesting German process for utilizing the well-known germicidal properties of silver in water sterilization. Mentioned in our news pages last month at the time the Congressional Country Club in Washington contracted for an installation for its swimming pool, the method is now described in somewhat greater detail on page 372 of this issue. Minute quantities of silver, as little as 25 mg. per ton of water, have proved effective in destroying bacteria. Sufficiently large installations now in operation in Germany should convince even the most skeptical that the method may have merit, oftentimes in uses not directly competitive with chlorine or the violet ray. Many possibilities exist in chemical manufacture and in the food and beverage fields where a gentle bactericidal action is impossible to attain by present means. The silver method may also prove useful for purification of drinking water on a small scale with portable equipment under conditions where sterilization by boiling is now the only resort.

To attempt to estimate at this time what, if any, significance attaches to this development as a competitor of chemical sterilizers is obvious folly. Yet those of our readers of a mathematical bent who like to speculate on interesting possibilities may easily convince themselves that were this process to be applied on anything like a national scale, it would put to shame all the efforts of a decade of "silver senators" and "16 to 1" congressmen.

A Chilean Revival?

OUR usually well-informed correspondent and close observer of Chilean conditions writes us as follows:

> I have not seen any comment in the American press on what seems to be the most important point in the existing nitrate situation. Under the present reorganization of the industry in Chile, which practically amounts to passing through bankruptcy, the cost of Chilean nitrate bears no capital or amortization charges. As a result I believe that Chilean nitrate can be placed in the United States and Europe at well under $20 per ton. The low value of the Chilean peso in foreign exchange is quite important in this cost. Some of the newer plants have also sold considerable sodium sulphate, especially to Europe, and I hear that prices as low as $12.50 per ton have been quoted. It is possible that this will become a regular byproduct, even of the older plants. Ocean freights are low. The profit from iodine, though much less than formerly, is still an item. Two or three years ago the Chilean nitrate industry was definitely marked as on its way out; today it can undersell synthetic sodium nitrate!

Whether or not our correspondent's final conclusion is sound, we cannot say, for it has not been our privilege recently to compare the costs of the natural and synthetic producers. But we do see other evidences of a budding revival in Chile. Commercial Attaché Bohan at Santiago reported that nitrate exports from Chile during the 1933-34 nitrate year (as of May 19) totaled 1,088,830 metric tons, compared with 185,000 for 1932-33. In his recent message to the Chilean Congress, the president of that republic declared that since May 1933 employment in the nitrate fields had increased from 12,358 to 16,110 workers; that monthly production had increased from an average of 36,109 tons to 52,162 tons and that four more nitrate plants are in operation at present than was the case a year ago.

All of which presages increasing competition for the synthetic nitrogen industry, particularly in the United States where the absence of tariff barriers and international agreements makes us the "happy hunting ground" for the foreign producer.

From Williams, "Building an Engineering Career," McGraw-Hill, 1934

"WHAT ABOUT MY JOB?"

Asks John Jones, B.S. in Ch.E. '34

Editor's Note: Within the month a thousand chemical engineering graduates have made their active bid for an eventual place in the profession. Perhaps it is an appropriate occasion, therefore, to see where we stand in chemical engineering—our shortcomings as well as our achievements. Carrying a step farther the theme of our April editorial "What Price Professional Progress?", Mr. McBride submits here a searching inquiry into the situation faced by the chemical engineer as an individual.

By R. S. McBRIDE

Editorial Representative of Chem. & Met.
Washington, D. C.

INDUSTRY is no greater than the personnel which runs it. A profession is no more valuable than the service of its members. This is true of chemical engineering as a profession and of the chemical engineering industry. A stock-taking on the ground of personnel is, therefore, more than justified, particularly in view of the recent entrance into the profession of a fresh crop of chemical engineering graduates.

The chemical engineer is an artisan, at least in the sense that he practices the art of applying to human affairs, chemical and physical science. As an artisan, he deals with more than science. He deals with raw materials, with money and with men. Most important of all are his dealings with other men, professional coworkers, superiors, subordinates. Without success in personal relationships of all these sorts he handicaps himself, may indeed be a failure despite great ability.

The beginning of success or the cause of failure for a man of average good personality can often be traced to little things occurring during his education and early training. Oftentimes it is the things of extra-curricular nature which are most important. But inevitably it is the influence of the faculty leadership which leaves its imprint on the college graduate. An appraisal, therefore, of the educational resources and limitations in chemical engineering rightly has become essential.

Thus far the profession has done very little to instill an understanding of professional ethics and conduct, to bring into the classroom the methods and thinking of modern industry. Only a few outstanding professors, principally those who do active consulting work as well as teaching, have been able to coordinate practical affairs with classroom and college laboratory. Perhaps some of the other and older branches of engineering have done little more in this way than the relatively young chemical engineering profession. But, this lack of attention to professional matters of vital personal importance offers no excuse for continuance of neglect on the part of chemical engineers.

Space forbids a detailed discussion of all of the opportunities which have not been seized. Only a few can be mentioned. In the first place, there has been a negligible effort on the part of practicing engineers of the industry to make the acquaintance of under-graduates, to cultivate their friendship to stimulate and guide their thinking. This can sometimes be done through the giving of lectures, through the getting together socially with the younger men, through the instilling in occasional per-

sonal conferences of ideas and ideals. Faculty men have been remiss in not demanding more insistently this co-operation from industry.

In the last few years great emphasis has necessarily been laid on the technical man's problem of getting a job. There has been all too little emphasis on the necessity of bringing desirable young men into every industrial organization that hopes to continue to grow. Fortunately, a turn in the tide seems to be under way. Therefore, it is now timely to think of the ways in which the selection of personnel is advantageously carried out.

Far too few firms take on each year a substantial number of cadets. Even an enterprise which is not growing rapidly can profitably do this. Oftentimes hiring a young man with college background for a job that does not need so much training proves to be an extremely worthwhile investment to the employer. The boys leaving college these days are not too "choosy." They are quite willing to put on their overalls, and go into the plant to give real labor and thoughtful attention to a subordinate job. They should not be made to feel like menials in such posts. They should be encouraged in the opportunity of thinking and planning. They should be given the encouragement of a larger opportunity when they show they deserve it.

A few years back industrial executives could not get enough well-trained technical men to fill more than a few key posts in their organizations. Highly-trained chemical engineers were so few in number that almost all had to be absorbed in the research and development departments, design work, and in the posts of technical assistants to superintendents and production managers. There is not yet a great surplus of chemical engineers, thanks to the rapid growth of the process industries. But there are enough now to fill a wider variety of plant positions. The selection of men with a grounding in science, with practical training in the chemical engineering art, so far as this may be learned from books and college laboratories, will be an investment in enlarged opportunity for the enterprise. The availability of these well-trained youngsters is one of our greatest assets.

It is unfortunately true that some college graduates stop studying when they leave the campus. Thereafter their growth is largely limited to their immediate contacts. This is largely the fault of the individual. But the management permitting such stagnation of its technical men cannot be altogether excused. Industry that drifts with personnel not constantly on the alert for advance, is left behind in the rapid progress of today's constantly improving technology. Specific plans, not haphazard examples, of stimulating personnel development after employment, are therefore needed. The lack of special training facilities in most enterprises is today a serious liability which counts against the industry quite as much as against the individual. An hour or two a week spent on company time either in following a definite course of instruction or in informal conference on departmental problems will usually prove a worthwhile investment.

In no other way does a man grow so rapidly as by professional association and contact with contemporaries of his own type. Industry must, therefore, stimulate the meeting together of its technical men.

This need not be on a formal, all-business basis. In fact the gain is greater if the association be a happy mixture of good fellowship with professional stimulus. Intra-plant, as well as inter-plant, conferences and social affiliations are necessary. Even so little a thing as frequent meetings in the plant lunchroom may be the basis of professional development and benefit to the employer. It is difficult to have lunch with a man pleasantly at noon and quarrel with him over inter-departmental differences at 2 o'clock.

Valuable Contacts

Man is a social animal. He travels in droves, in cliques, in crowds. Professionally his gregarious instinct may be made an asset if directed by the wiser, more experienced of the group. Most chemical engineering enterprises of this country encourage membership and participation in scientific and technical societies. This is a great advantage to the individual. Money and effort so spent, whether by the boss or the employee personally becomes an investment in and opportunity for professional development.

Chemical engineers as a group have taken far too little part in all-engineering enterprises. Although the American Institute of Chemical Engineers was among the founders of American Engineering Council, that affiliation was discontinued early in the depression. The Institute has not often participated with the four so-called Founder Societies, which lead in many worthwhile activities, representing civil, electrical, mechanical and mining engineers. A notable exception, however, is to be seen in the Engineers' Council for Professional Development. (See *Chem. & Met.,* January, 1934, pp. 16-17). This activity probably holds more promise for enhancing the professional status of the engineer than any other program developed in recent years. Chemical engineers in all walks of life will do well to read and study the first annual report of E.C.P.D., published December 4, 1933, and available from the office of its secretary, C. E. Davies, Engineering Societies Building, New York City. The formation of aggressive local chapters of the Institute or of other chemical engineering groups such as that at Neenah, Wis., (See *Chem. & Met.,* April, 1934, p. 202) will not only redound to the benefit of the profession, but will give the chemical engineer an opportunity to be heard locally on civic and business affairs where his word as a professional man would be worth listening to.

All this may seem remote from the problems faced by John Jones, B.S. '34 when he starts to work in your plant this month or next. He'll have his shortcomings but don't forget that we have some ourselves, individually, in our companies and in the profession as a whole. The sooner we face the facts and build for the future of chemical engineering as a profession the more certain will be our progress.

By DEAN CLARK
Director, Code Authority, Chemical Industries, New York, N. Y.

LABOR PROBLEMS and POLICIES

Chemical industry is fortunate in having as its code director an outstanding industrial engineer of long experience in management and administration. His address before the annual meeting of the Manufacturing Chemists Ass'n. contains some interesting and thoughtful advice for executives of process industries—which fortunately have been remarkably free from labor difficulties.—Editor.

MANY PEOPLE believe that the labor section of the National Industrial Recovery Act was a sudden and radical step, but they have overlooked the sequence of events that led up to it. Over many years there has been a series of court decisions which have established the right of labor to organize for the purpose of collective bargaining. In 1926, Congress passed the Railroad Labor Act which required the carriers to deal with representatives of their employees chosen without interference, and in 1932, Congress passed the Norris Act in which is included the expression (later found in Section 7-A of NIRA): "Designation of representatives of his own choosing and free from interference, restraint or coercion of employers or their agents."

Thus we see the successive steps approaching the present situation: (1) The recognition of the right to organize and bargain collectively. (2) Restraining the employer from interference with the selection of employee representatives. (3) The employer prohibited from requiring that employees refrain from joining a union. (4) The Recovery Act requires employers to recognize and observe all these conditions.

For many years, there has been a steadily growing appreciation on the part of enlightened management of the need of better relationship with employees and many companies have taken the initiative by assisting in the development within the plant itself of plans for employee representation, not only for the purpose of dealing with terms of employment but also to provide for the exchange of opinion leading to the solution of the many problems arising in every factory and in which both management and employees have interests in common. Some of these plans have been outstandingly successful and in many ways, mutually beneficial.

Organized labor, on the other hand, suddenly recognizing the opportunity afforded by the Recovery Act, took broad steps to expand and the old trade union classifications have been supplemented by new "vertical unions" intended to embrace all the employees of an establishment regardless of crafts. This new phase of organized labor has naturally added considerably to union membership but has also led to conflicts within the ranks of labor as to jurisdiction, and has added much confusion to an already disturbed situation.

Some notes as to the legal aspects of the famous paragraph 7-A of NIRA may be in order:

(1)—The language of paragraph 7-A is not intended to be a complete statement of all the rights and privileges of employees and employers. The intention and effect is to describe certain rights of employees, many of which have long been recognized by management.

(2)—Employees are free to choose any method they desire of dealing with management as to wages, hours, and working conditions. Collective bargaining is a right which they may exercise if they so elect, but the section does not compel that form of dealing to the exclusion of other methods. They may deal through a trade union or through a plan of employee representation confined to the employees of a company, or they are free to handle their affairs individually if they so desire.

(3)—No contractual relationship may be entered into with one or more groups which will have the effect of depriving others of their right to bargain in their own way.

(4)—The obligation to bargain with employee representatives carries no obligation to accede to demands or to enter into any contract.

(5)—The law forbids requiring membership in a company union as a condition of employment but such organizations should not be confused with employee representation plans (erroneously called "company unions") which do not have any such requirement, and where participation is on a purely voluntary basis.

(6)—Management has the right to know whether those purporting to be duly chosen representatives are such in fact, and whom they in fact represent.

(7)—The section gives no right to third parties as such, but in forbidding coercion it does not forbid co-operation of the employer. The President contributed a valuable service when, in the automobile dispute he said: "The Government makes it clear that it favors no particular union or particular form of employee organization or representation. The Government's only duty is to secure absolute and uninfluenced freedom of choice without coercion, restraint or intimidation from any source."

Conflicting opinion in Washington is indicated by the fact that the National Labor Board has maintained that employers must sign contracts with employees and also that representatives selected by the majority of employees in a given plant are the sole bargaining agency for that plant. As to this, Mr. Walter Teagle, Chairman of the Industrial Advisory Board, quotes General Johnson as follows: "It is the worker's choice as to whether he is to bargain individually or collectively through representation. If any employer should make a contract with a particular organization to employ only members of that organization, especially if that organization did not have 100 per cent membership among its employees, that would in effect be a contract to interfere with his worker's freedom of choice of his representatives or with his right to bargain individually, and would amount to employee coercion on these matters, which is contrary to law."

Strikes' Costly Toll

The period following a depression is usually marked by an epidemic of strikes and it appears that we are now entering such a period in which the disputes cover more than the question of wages. The most critical problems do not lie in wage scales. Continuity of employment is far more important to sustain the high standards of living in this country which have been attained by the constantly increasing capacity of American industry to produce more of the things the people desire.

The appalling magnitude of losses to employees alone caused by strikes is shown by the fact that during the last six months of 1933, there was a loss of over 11,000,000 man-days due to industrial disputes. Assuming an 8-hr. day, this would amount to over 88,000,000 man-hours and taken at the December average hourly earnings of 51.2c. reported for 15 industrial groups, this would mean a wage loss of over $45,000,000. This amount is greater than the value of the total output of the automobile industry in some of the worst months of the depression. How can it be expected that prosperity can be restored by further increase in wage rates and shorter hours in the face of the rejection by labor of such gross amounts in wages?

The greatest assurance to the employee of good wages and proper working conditions is predicated upon the business of the employer being reasonably prosperous.

Chemical industry is outstanding in its important relations to other industries; in the sphere of health and in the national defense as referred to in Article IX of the Chemical Code. The very nature of its business and its manufacturing operations requires exacting and technical skill to insure quality and safety, and chemical plants and operations cannot be run from the outside.

The over-emphasis being given to the term "collective bargaining" and the accompanying "rights" of employees, all of which have been recognized and given effect long before the Recovery Act, has tended to obscure in the public mind the real fundamental responsibilities of management.

The prime responsibility of management is to maintain an equitable balance between labor, stockholder and consumer, and anything which tends to disrupt this equitable balance is wrong. There has grown up in recent years a recognition by management and employees of the desirability of cooperation, and a better conception of the interests of labor and management as being essentially mutual and not antagonistic.

Enlightened management which has accepted this principle has found successful methods of employee representation under which employer and employee can agree, avoid conflict, and unite to further their mutual interest in the welfare of the business.

This basis of proper employee representation rests upon the foundation of a community of interest within a business enterprise. Such representation plans are not anti-union and often union members are to be found on works councils working harmoniously with non-union representatives. In such plants the experience with employee representation is that the employees are indifferent to efforts to organize them because unionism offers no advantages over what they already have.

A sound form of employee representation is essentially a part of good management, for it is through such means, when rightly handled, that employers, as well as employees, will educate themselves to understand the problems and points of view of each other.

It is good business for the management and employee representatives to join in determining the essential facts as to their common problems, interpret them and develop a basis that can be agreed upon for procedure that will be understood and be mutually beneficial.

Employee representation has these definite aims:

(1)—To furnish facilities to adjust grievances and prevent injustice.
(2)—To serve as a means for collective bargaining on wages, hours, and working conditions.
(3)—To provide for the exchange of information and opinion between management and employees.
(4)—To educate employees and management to understand the viewpoints and problems of each other.
(5)—To promote efficiency, economy and safety, and to strengthen morale.

Employee representation will not succeed if:

(1)—The employer attempts to rule with an "iron hand."
(2)—He is not willing to commit himself to pay at least the prevailing wages for similar work in the locality.
(3)—He is not prepared to yield on some questions that may arise.
(4)—He is not willing to deal frankly and openly with his employees.
(5)—He is not willing to let his employees select their own representatives and methods of collective bargaining.

Considerable light is shed upon the present methods under which industry is dealing with employees by examining the results of a recent nation-wide survey made by the National Industrial Conference Board. The study covered 2,700 companies having over 2,000,000 employees and represents a broad cross-section of the country. Of this group those firms dealing individually with their employees represented 43.9 per cent of the employees. Those dealing through employee representation, 46.6 per cent of the employees, and through organized labor unions, 9.6 per cent of employees.

England's Experience and Cure

It may be of interest to note the experience in England with an attempt at union domination which brought on the general strike of 1925 and was followed by the British Trade Disputes Act. Under this Act, England:

(1)—Defined by law and distinguished legal from illegal strikes.
(2)—Provided for the control of trade union funds.
(3)—Prevented expenditure of trade union funds in support of illegal strikes.
(4)—Gave the individual the right of recovery against trade union leaders who undertook by coercion to compel him to take part in an illegal strike.
(5)—Provided that in government service, no distinction should be made in the letting of public contracts between those who employed union labor and those who did not.
(6)—Invalidated contracts in which discrimination is permitted between members or non-members of labor unions in the execution of contracts.

The British Act of 1927 introduced various limitations upon the right to strike, the chief being that:

(1)—Any individual engaging in a trade dispute is liable to criminal proceedings if, by breaking a contract of service, injury or danger or grave inconvenience to the community is likely to result.
(2)—A strike is illegal which has any object other than or in addition to the furtherance of a trade dispute within the trade or industry in which the strikers are engaged.
(3)—A strike is illegal if it is designed or calculated to coerce the Government either directly or because it would be reasonably likely to inflict hardship upon the community.

The last two of these provisions would unquestionably make illegal a general strike and most sympathetic strikes, whatever their objects might be, and would also make illegal any strike the objects of which extended beyond hours, wages, and other conditions of employment. The illegality would hold even though the workmen had terminated their contracts of service. Any trade union official or other person who declares, instigates, incites others to take part in or otherwise acts in furtherance of an illegal strike or lockout is liable to criminal proceedings; the mere cessation of work is not, however, a criminal offense.

It is enlightening to observe that this act passed in 1927 has withstood several years of a labor government and is still in force.

That industry has made effort to provide work for its employees during the period of depression is evidenced by comparing the income produced and the income paid out by the broad industrial classification of "Manufacturing" taken from the report of the N.I.C.B. previously cited:

In 1929—Total Income Produced $19,354,000,000.
Labor Income Paid Out $14,984,000,000 or 77.4 per cent of total.
In 1932—Total Income Produced $5,873,000,000.
Labor Income Paid Out $6,961,000,000 or 118.5 per cent of total.

In other words, in 1932 "Manufacturing" paid out to "Labor" $1,088,000,000 more, or 118.5 per cent of what it took in as the proceeds of doing business. This shows the extent to which industry was living on its capital. In fact, in four industrial groups the income produced in 1932 was not sufficient to meet wage and salary payments.

I believe that the principle of the community of interest centering around each plant is the foundation upon which can be built up a relationship between management and employees so strong and satisfactory to both, that outside influences can offer nothing to compete with its mutual benefits.

I believe that the best means so far devised for the development and protection of the interests of management and employees alike, is the works council made up of freely chosen representatives of the employees to meet with representatives of the management for the consideration of affairs common to both. There is a latent capacity among employees both of ideas and effort that can be drawn upon if given the opportunity.

It is the responsibility of management to provide the setting for the development of confidence between employees and itself, and if both exercise the qualities of patience, tolerance, judgment, and good will, there is reason to expect a real community of interest of lasting benefit to all concerned.

PHENOLIC RESIN EQUIPMENT IN CHEMICAL INDUSTRIES

By WILLIAM H. ADAMS, JR.
Technical Director
Haveg Corp., Newark, Del.

Phenolic resin tank with dished head, liquid level window, and plug outlet in bottom operated by lever mechanism. Note manner of holding on head, with split steel angle ring in a slot, bolted to a flat steel ring placed over the head.

IN THE CHEMICAL INDUSTRY there has been a considerable recent development in the use of phenolic type resins, particularly in corrosion-resistant chemical plant equipment. This is due to certain properties of these resins which make their use under these conditions especially desirable. Such resins are hard and strong. They do not melt nor soften appreciably at moderately elevated temperatures nor are they injured even by prolonged exposures up to about 135 deg. C. They do not crack with sudden temperature changes. Finally, they are extremely resistant to the action of moisture, most acids and solvents, many of the weaker bases, and numerous other chemicals, and are, therefore, capable of solving many problems in the handling of corrosive materials.

The resistance of phenolic resins to chemical attack has long been known, and was, in fact, noted by many of the early investigators[3,4,5]. It is, therefore rather surprising at first sight to note that until recently there has been no significant development in the use of these materials in chemical plant equipment. Actually, however, the problem was a rather difficult one, partly because of manufacturing limitations and partly because of the economics of the situation.

Two general types of reenforced resin products have been developed to fill the need for a stronger material. The first is the so-called "molding powder" which consists essentially of an admixture of resin and a fibrous filler, usually wood flour or asbestos. The powders are formed under heat and pressure in intricate molds. This process lends itself admirably to the quantity production of small parts, but for chemical plant equipment, where the size is large and the quantity limited, the cost of the molds is so excessive that the process becomes economically unsound.

The second type of reenforced resin product is the so-called "laminated" material, which usually consists of layers of paper, cloth, or asbestos, impregnated with resin, and bonded together with heat and pressure between plates in a hydraulic press. This product is tough and strong, but can only be made cheaply in a few relatively simple shapes, such as sheets, rods, and tubes. While tubes and a few other forms can be used directly as constructional material for pipes, towers, and the like, the complicated apparatus needed by the chemical industry could for the most part be built up only by the hand fitting of small pieces. This process is too expensive to be generally applicable.

In addition to the economic limitations of these materials, there have been, until recently, chemical disadvantages as well. In the early days of the industry, the major emphasis was on a material for electrical insulation; when attempts were made to apply such grades in the chemical industry, they were found to be entirely unsuitable. Traces of acid could penetrate the mass and disintegrate the usually rather crude cellulosic materials used as fillers.

Recently, however, new grades of these products have been developed for chemical service which represent a marked improvement. This improvement was attained by the use of more resistant resin, purer types of cellulose and better manufacturing technique.

It should be emphasized that while these grades can be used with a large number of acids, salts, solvents, and weak bases, they can in general only be used under moderate conditions of concentration and temperature. This is because even with the advances which have been made, it is still possible for strong hot chemicals to penetrate sufficiently to cause eventual deterioration of the cellulose. When used under the correct conditions, however, such products have an excellent life expectancy, and their strength, toughness, light weight, resistance to rapid temperature changes and ready machinability combine to make them adaptable materials from the design standpoint.

Among the types of equipment of this nature which have been made may be mentioned rayon spinning buckets, drying trays, pumps, towers, and tower sections, pipes and fittings. Laminated type pipe for hydrochloric

Based upon a paper presented before the American Institute of Chemical Engineers at the New York meeting, May 14, 1934.

acid service has been one of the major applications of this product to date.

The economic and chemical limitations of the conventional phenolic plastics as applied to plant equipment led to further research with these materials. From this study a new type of plastic has been developed, of distinctly improved chemical resistivity, from which large and complicated chemical equipment can be produced at costs entirely within reason. This was developed in Germany about 10 yr. ago by the Saureschutz Gesellschaft M.B.H., and is known under the trade name of Haveg[6,8].

The improved chemical resistivity of Haveg is due in great part to the fact that instead of cellulose as a filler, a special type of treated asbestos is used, which is itself quite resistant to acids. In conjunction with this asbestos is used a phenolic resin of a distinctly unconventional type, and superior to most conventional resins in toughness and imperviousness to moisture. Penetration of acid into the mass is therefore greatly reduced, and will not cause disintegration in any case, since the filler is not subject to attack. In addition to the chemical resistivity, the fibrous asbestos, interlaced in the molded mass, gives Haveg a considerable degree of strength and shock resistance.

Large and complicated pieces are made economically feasible by the fact that the process permits the reduction of molds and mold charges to a minimum. As with conventional materials, the molding of Haveg involves the use of heat and pressure, but the molds required differ from conventional types in that a relatively flimsy construction is permissible. Molds can, in fact, be made from nearly any constructional material, including wood, metal, and even cloth, and this naturally results in greatly lessened production costs, especially where only one or two pieces are required of a given type.

This feature makes it possible, for instance, to mold a single piece tank 9 ft. in diameter and 9 ft. high, in which the total mold and tooling charge is in the vicinity of $30. The possibility of molding large pieces of equipment at nominal cost has resulted, in the space of a few years, in the production of a large number of diverse types of Haveg apparatus for the European and American process and textile industries. Among these types may be listed cylindrical and rectangular tanks, scrubbing, reaction and fractionating towers, filter press plates and frames, crystallizing pots, drying trays, agitators, buckets and dippers, fans and ventilators, fume ducts, pipe, valves and fittings, pumps, drip pan systems, separators, precipitators, vacuum filters, shipping containers, dyeing machines and other textile equipment, and many others. The chemical engineer responsible for the selection of equipment should have a good understanding of the basic fundamentals of Haveg design, of its major utility, and of its physical and chemical limitations.

The essential consideration in regard to design of Haveg equipment is the fact that this material is a molded plastic, not a metal. Apparatus should, therefore, be as simple as its intended use will permit, While the process permits their inclusion where necessary, undercuts, hollow sections and sharp internal corners should be avoided, as they increase expense. Wherever sharp directional changes must be included, as in joining tank walls to the bottom, a fillet should be provided. Both thin sections (below $\frac{1}{4}$ in.) and thick sections (above 2 in.) cause difficulty in molding, and should not be employed.

The strength of Haveg (tensile, 2,500 lb. per sq.in., transverse 5,500 lb. per sq.in., compressive 10,500 lb. per sq.in.) is entirely adequate for self supporting apparatus even in large sizes, but it follows that heavier wall thickness should be used than with a metal, up to about $1\frac{1}{4}$ in., for example on a 9 ft. x 9 ft. tank. Where abusive mechanical conditions exist in large equipment, and where it is desired to use the minimum thickness, external reenforcement should be provided. On cylindrical tanks this takes the form of metal bands or a combination of wooden staves and metal bands. In cases of heavy internal pressure the Haveg tank can be completely enclosed in a steel shell. On rectangular tanks the reenforcement consists of a steel rib structure. In the case of agitators the reenforcement is internal, consisting of a rigid metal core.

The size of individual units of Haveg equipment is limited by existing manufacturing equipment to about 12 ft. high, with an 18 in. diameter or about 9 ft. with a 9 ft. diameter. This does not limit the size of finished equipment, however, as individual sections can be joined together to form tall towers, long rectangular pickling tanks or pipe lines. This is accomplished in the case of towers by placing a split angle ring in a slot on either side of the joint, and bolting together on a gasket. Pipe lines are joined by a split ring placed in a slot in the Haveg, and followed up by a solid flange. In this general manner equipment can be produced of considerable length, heads can be fastened on tanks and many other modifications can be accomplished.

It should be emphasized that Haveg is not a plaster or dope which can be applied as a coating or lining to existing equipment. It is, on the contrary, a solid constructional material. The acid resistance is therefore the same throughout the entire mass. This opens up the possibility of repairs to or alterations on existing Haveg apparatus, as the new surfaces thus exposed are just as resistant as the old.

Among the physical limitations should be mentioned the fact that being a plastic, it cannot normally be held to close dimensional tolerances. It has a low coefficient of heat transfer, which while an advantage as far as heat losses are concerned, precludes its use in heating coils or steam jackets. Haveg is unaffected even by

Three-bladed Haveg Agitator molded over a steel core to add strength and rigidity

rapid temperature changes, due to its low coefficient of expansion, but it is not recommended for use at temperatures above 135 deg. C. because there is a continued polymerization of the resin beyond this point which tends to form gas and blisters.

In regard to the chemical utility and limitations of Haveg, there is fortunately a groundwork of European experience from which fairly definite recommendations can usually be made[6,7]. It will be noted that Haveg is resistant to most inorganic and organic acids (including hydrochloric even at boiling temperature) to many solvents and salts, to certain of the weaker bases, and to a number of other chemicals, including chlorine, but not bromine or iodine. The strong oxidizing acids such as nitric, chromic and concentrated sulphuric, attack the organic resin bond in Haveg, as do also the strong caustics like sodium hydroxide, strong resin solvents like acetone, and the organic bases of the aniline series.

Hydroflouric acid and the flourine compounds would naturally attack the asbestos filler used in ordinary Haveg, but a special grade is available which contains a carbonaceous filler and which is therefore resistant to these compounds.

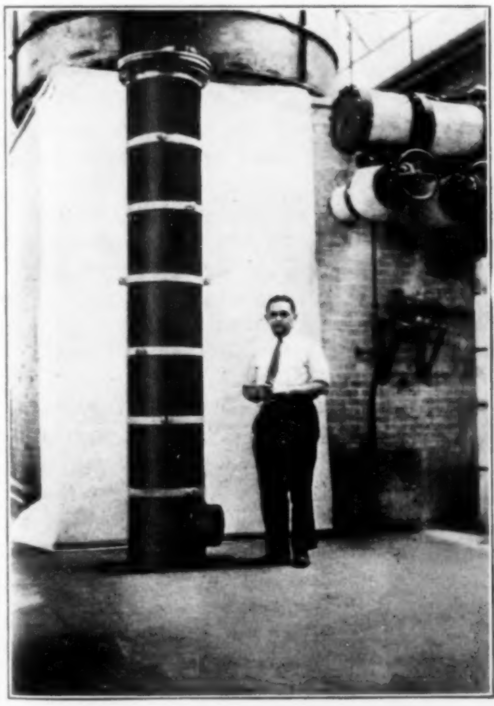
There are many cases where definite recommendations based on past experience cannot be given. While predictions of Haveg service can frequently be made by analogy in these cases, it is always safer to try samples with the chemicals in question. In this connection, the writer has found laboratory tests not always conclusive, and believes it is better to make such tests under actual plant conditions by suspending the sample as near as possible to the location where Haveg will be used.

There is still another modification of the phenolic resin plastics which has recently found considerable application in the chemical industry. This is a cold-setting acid-proof cement, known in the trade as Havegit. It consists of a putty-like combination of fillers with a phenolic resin which upon the addition of an alcoholic solution of sulphuric acid, hardens within a few hours' time to an insoluble infusible state not unlike that obtained with heat and pressure. The chemical resistance is just about the same as with Haveg.

The major utility of this cement is in the setting up of tile or brick linings in tanks, towers or reactors. It has also been used to cement in place Haveg sheets as a lining in pieces too large to be made of solid Haveg units. In both cases a double or triple layer construction is recommended, with staggered joints to avoid pinholes or other imperfections in installation. Havegit is not usually satisfactory when used alone as a coating, because of the adverse effect of expansion differences between it and the existing apparatus.

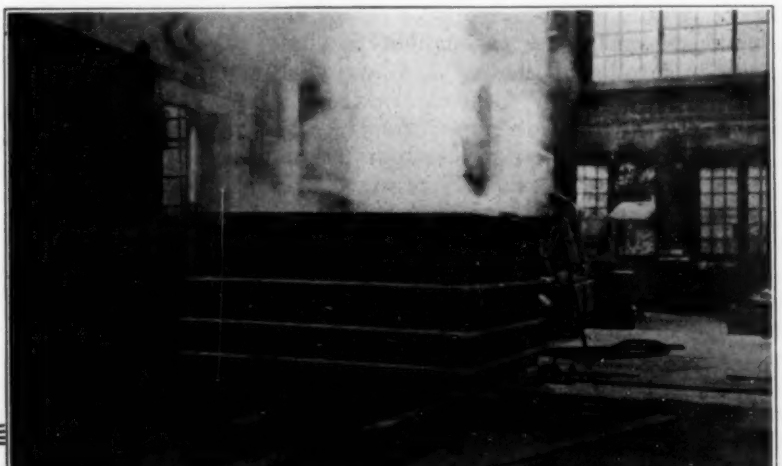
It should be pointed out in conclusion that in addition to the severe cases where the utility of these materials is more or less obvious, there are other more moderate cases where fairly satisfactory operation is now possible, yet where the phenolic plastics can show advantages. In such cases the consideration is largely economic and the decision rests on the relative costs and life expectancies of the respective materials.

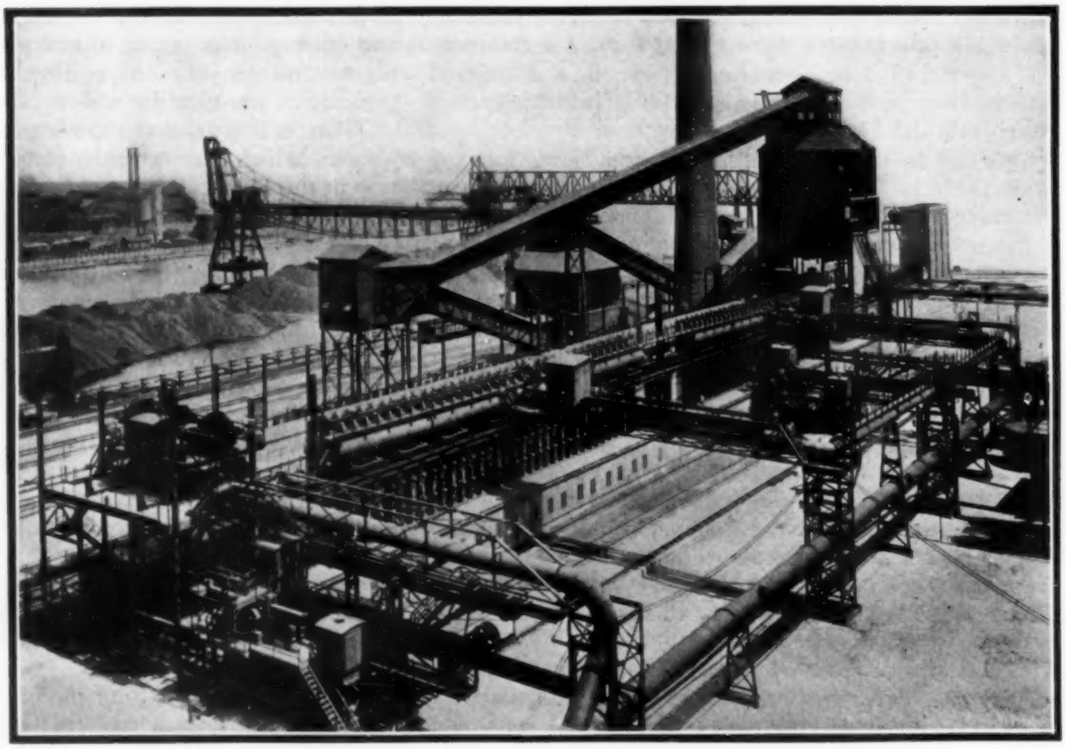
1.—Ellis—"Synthetic Resins and Their Plastics" (Chemical Catalog Co.—1931)
2.—Scheiber & Sandig—"Synthetic Resins" (Pitman—1931)
3.—Luft—U. S. Patent 735,278—August 4, 1903
4.—Story—British patent 8875—1905
5.—Baekeland—*Ind. Eng. Chem.*—p. 155 (1909)
6.—Lecach—*Agnew* vol. 38 p. 1092 (1925)
7.—Petroff—*Kunstat* vol. 16, p. 251 (1926)—vol. 17, p. 65 (1927)
8.—Wirth—*Chem. Ztg.* vol. 49, p. 653 (1925) vol. 51, p. 349 (1927)



Synthetic resin washing tower with removable top and integrally molded outlets. Steel bands are used to aid in withstanding pressure.

Rectangular Haveg digestion tank. External steel ribs are used to add strength and to protect from injury.





Throughout the byproduct coke plant the engineer is troubled with coke abrasion. To resist it he is using rubber, tile, vitrified brick, cast iron, tungsten carbide, and other materials

Wear Resistant Materials for Coke Handling Equipment

By CHAS. R. LOCKE
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A QUESTIONNAIRE was sent to twelve large and medium sized gas plants to determine, if possible, any increase in applications of new materials for special services and to determine to what extent newly designed equipment was in use throughout the industry. This covered the following items: 1. Wear resisting materials and their application, 2. Coke chute design, 3. Coke screen design, 4. Welding and its application, 5. Chute linings.

The general opinion received in the replies to this questionnaire was that no definite rule could be laid down for the application of new materials to special service but that each problem must be worked out individually.

The chief application of abrasion resisting material lies in its use in crushing equipment, screens, chutes and other parts of the plant which are subjected to the abrasive action of moving coke. Under this heading comes the use of hard cast iron, nickel-chromium irons, manganese steels, Stellite, Stoodite and tungsten carbide applications, brick, tile and rubber.

Based upon paper presented before A.G.A. Production and Chemical Conference, May 22, 1934.

Hard cast iron of the mottled type with an average brinnell hardness of 350-450 has been used in one plant for grizzly disks and chute liners for some time and has given good results at a comparatively low cost. Grizzly disks made of this material will usually screen between 50,000 and 60,000 tons of coke before showing 10 per cent oversize in the coke passing through the grizzly.

The most common material used for chute lining is vitrified brick which gives excellent satisfaction and much longer life at lower cost than cast iron. One advantage of a brick-lined chute lies in the fact that replacement can be made of a portion of the brick without renewing the whole chute. Vitrified brick is widely used as surfacing for coke wharfs, replacing the cast iron plates which were formerly used for this work. In locations where it is impossible to hold brick, hard cast iron or some of the alloyed irons are used and give good service. Rubber has been used for chute lining but no information as to its cost or service is available.

The use of special cast irons usually carrying an appreciable percentage of nickel and chromium are

recommended by the manufacturers for preventing abrasion. These special materials usually cost three to four times as much as the hard iron and, hence, to be economical must deliver proportional service. Location of the plant in reference to the shipping point of the special iron is an important factor as to freight rates on the finished material, on the scrap returned, and the speed with which replacement material may be obtained either for maintenance or new construction.

Coke crusher segments are usually constructed of cast iron of special analysis or of special manganese steel. One of the most important characteristics of a metal in this service is its ability to withstand shock. With this in mind the more expensive manganese steel is probably the safer. Recommendations have been made that the edges of coke crusher segments be tipped with Stellite but no experience with the use of the alloy in this service was reported.

Materials in use for screen cloth vary from the ordinary bright wire through piano wire to manganese steel. Each plant seems to have a particular material which works best in its set-up. Vibrating screens present a particularly difficult problem in that breakage of the cloth often occurs before the screen is worn out.

Other wear resisting materials which may be mentioned are rubber, which is widely used for lagging pulleys exposed to abrasive action and sometimes for lining chutes, and vitrified brick and tile which are in common use for chute lining, coke wharf surfacing and the like.

Stellite, Stoodite and other hard facing materials are usually furnished in the form of welding rods and applied to the wear-resisting surfaces by either acetylene or electric welding. These rods are usually non-ferrous and composed of alloys of cobalt, tungsten and chromium. These materials while expensive often show an economy when applied to such parts as hammers for coal pulverizer, large sprocket teeth, ram shoes, carbon cutters, water cooled beams in water gas machines, or similar services where great resistance to abrasion is required. Tungsten carbide is also available in a form of welding rod and has been used by one operator with good results on barring tools.

One class of materials which has not been touched on, as yet, is the use of refractory linings for oven standpipes and door linings. Many plants in the last few years have replaced their cast iron standpipes with ones composed of a welded steel shell lined with two or more inches of refractory material. Two general types of refractory are used; first, one which is plastic and must be rammed into the standpipe mold; and secondly; the type which can be mixed fluid enough to be poured as ordinary concrete. The substitution of these materials for the cast iron formerly used has greatly decreased the cost of standpipe maintenance. Recently the use of poured linings has been extended to the lining of oven doors, and in plants where door brick and brick laying labor are expensive large economies have resulted. Oven floors can be kept in tight condition by floating a thin layer of certain specialized cements over the old bricks rather than by expensive replacement of the floor brick.

Under the heading of corrosion resistance come the materials which are used in order to procure longer life of operating apparatus at a lower cost. A large number of materials are recommended for use in different applications in combating corrosion but only a few can be touched on in this summary.

A particular problem of gas plants is the corrosion of the sheet metal used in covering conveyor galleries and buildings. Substitution of alloy or wrought iron sheets for the straight black, or galvanized, iron shows in most cases a saving particularly where sheeting labor is expensive. Better protection can be secured by use of the pressed or molded sheeting material, such as transite, where first cost and weight are of minor importance. One important factor in the protection of steel work is the corrosion that occurs at points where it is impossible to inspect unless the sheeting is removed.

In byproduct coke plants using recirculated water for quenching coke a rapid corrosion of seal rings and pump shafts takes place. The use of stainless steel, or stainless steel sleeves, increases the life of these parts many fold. Also shafts and rings of this type give exceptional service in handling hot ammonia liquor and tar. One operator reports that the use of a nickel-copper alloy for the impeller of a quenching pump has increased the life of these impellers from six to eight weeks to more than two years, which means a worthwhile saving in dollars.

An unusual adaption of stainless steel pipe was noted at one plant. It was necessary to insert a bent ½ in. pipe through the standpipe into the stream of hot high-sulphur gas coming from the oven. This pipe was used in blowing high-pressure steam up through the standpipe in order to remove carbon deposits from the oven. Such a pipe made of mild steel lasted on the average of 48 to 72 hr. while the stainless steel increased the life to 60 to 90 days. One plant reports a saving by the use of

Vitrified brick, tile, cast iron, and alloyed cast iron are the surfacing materials most generally used to prevent abrasion on the coke wharf

stainless steel for bushings and racks on salt cutters and in welding a plate of stainless steel on the cast steel bottoms of the dryer baskets.

Several plants have been troubled by the carry-over of acid fog from the saturator to such an extent that valves and piping directly after the saturator were corroded to the danger point in a comparatively short time, necessitating costly and dangerous shut-downs. Substitution of the cast iron pipe with lead-lined steel pipe as far as the first drip pot takes care of the pipe corrosion problem while the use of bronze seats and disks is recommended for the valves.

Another method of protection of metals from corrosion has been developed and although no specific information of its use in gas plants is available, it seems quite promising for certain applications. This is the spraying of many commercial metals on the surface to be protected. The process consists of atomizing the molten metal and spraying it on the sand blasted surface of the material to be protected. The range of materials is wide and it is possible to coat a casting with almost any metal from zinc to the stainless steels.

Discussion of coke chute design depends upon the controversy as to whether it is better to handle the coke roughly throughout the handling system and so minimize further breakage for the customer or to handle the coke carefully throughout the coke handling and have a certain amount of breakage take place in the car or boat. Most operators, I believe, hold to the latter opinion.

To that end various schemes have been worked out to minimize breakage such as, installing spirals at corner turns to eliminate straight drops, alternating the slope of chutes, installing baffles to retard the flow of coke, and other changes which will distribute the coke more uniformly to crushers and screens. Some operators prefer a chute of U shaped cross-section to a straight chute flanked by skirt boards at points where the chute delivers coke to a conveyor belt.

One plant uses a novel method of transfer in that the first belt discharges on to a shelf which fills up with coke to its angle of repose and feeds the next belt. Here the wear is coke on coke, plus a more even feeding of the second belt. In certain locations a modification of this shelf or box is being used to eliminate flapper or by-pass gates. This is accomplished by having hinged sides to this box and making the coke drop in either direction—depending on which side is opened.

Little new information has developed regarding lowering and withdrawal chutes although some operators are coming to believe that the advantages secured by these chutes in lessening breakage are in some cases offset by high first cost and maintenance charges, reduced bin capacity, and the accumulation of pockets of small coke and breeze which discharge at intervals causing complaints from buyers.

While within the past few years several manufacturers have added vibrating coke screens to their line, in general these screens are not designed for coke plant service and have usually developed difficulties when placed in coke plant service. Refinements in screen design are constantly being brought forward. One such is a design in which the eccentricity can be changed in about five minutes which is an additional refinement to those possessed by many other screens in being able to adjust the angle of slope and also to run backward or forward. One make of screen is in operation for screening breeze in order to recover that portion over a $\frac{1}{16}$ in. slot and is doing a satisfactory job with this difficult material.

One operator expresses himself as follows:

"We believe that much of the difficulty due to screens not obtaining expected efficiency may be due to a poor delivery to the screen or inability to set the screen at the most favorable angle because of improper design of the chutes delivering to it. In the future, wherever possible, we propose to provide, in the erection plans for considerable flexibility in this respect so the exact screen angle and point of delivery may be established in the field. In some cases this may be taken care of by an arrangement for raising or lowering the head pulley of a conveyor delivering to a screen or to a chute leading to the screen."

Another operator describes an ideal screen as one having the following characteristics: 1. It should be rugged and one which routine maintenance will not put out of adjustment. 2. It should have adjustable speed and stroke because for each speed there is a corresponding stroke to give maximum rate of screening. 3. It should have a true circular motion throughout the entire screening area. 4. It should have variable angle adjustment. 5. It should be so designed as to allow screen cloths to be changed simply and quickly. 6. It should have a feeding device to insure even distribution across the width of the screen of the material being fed.

Very little definite information was obtained concerning the use of welding in and about gas plants. However, it is well known that the use of both electric and gas welding has come into wide application particularly in the building of tanks, pipe lines, patching collecting mains, building up worn castings and the like.

Within the past few years the use of the "shielded arc" method of welding has been widely used. The rod used in this process is coated with substances which permit of higher operating speed and the resulting weld is usually more ductile than that from uncoated rod.

Tops of the Koppers coke-fired gas producers used to make gas to heat ovens and to mix with sendout gas

Application of Refrigeration to the Manufacture of Natural Gasoline

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EMPLOYING refrigeration to economic advantage in the manufacture of natural gasoline is a possibility that is usually dismissed with the suggestion. Such an attitude is rather difficult to understand in view of the fact that absorption is a vapor pressure phenomenon and depends on the lowering of the vapor pressure through solution. In this respect, the temperature of the absorber is all important.

The temperature of the absorption oil likewise has an important effect on the volume necessary to absorb the desired gasoline from the gas. It also has a great effect upon the quality of gasoline absorbed. The lower the temperature in the absorber, the more selective is the oil. In other words, by circulating a small volume of cold oil, the same extraction of a more stable gasoline will be obtained as by the circulation of a much larger volume of warm oil. The reason for this is that the quantity of any constituent absorbed is inversely proportional to its vapor pressure. As the temperature rises the vapor pressure of the heavier and more desirable constituents rise proportionately faster than the lighter fractions.

The vapor pressure of the gasoline constituents left in the oil from the still is higher as the oil temperature is higher, and this condition will also retard absorption. This is another important reason for cooling the oil to as low a temperature as possible. In general, a decrease in lean oil temperature of 1 deg. F. represents an increase in absorption efficiency of 2 per cent. There are probably many plants in which the oil temperature could be reduced at least 10 deg. F. by more adequate cooling facilities. The result would be a 20 per cent increase in extraction efficiency. Even if the extraction were adequate, the reduction in oil temperature would permit a 20 per cent decrease in oil rate with a corresponding reduction of load on pumps, exchangers, still, condensers, coolers, boilers and cooling tower. The savings by carrying out absorption at temperatures around 40 to 50 deg. F. will more than justify the expense of obtaining such conditions.

The methods for obtaining these low temperature conditions are of course available from the ice and cold storage industry. Here the two conventional processes for producing refrigeration are the absorption and compression systems, with the latter in overwhelming predominance. The merit of the compression method, aside from its advantage in first cost over that of an absorption machine of the same capacity, lies in its ability to be forced to operate satisfactorily with cooling water temperatures well over 85 deg. F., a condition which is not at all abnormal in gasoline practice. Such temperatures merely involve the use of high head pressures, which result in an increase in proportion of the horsepower per ton of refrigeration output.

As the absorption method is essentially one of low temperatures, its use in the range of 40 to 50 deg. F. generally proves uneconomical. Further, although the method is exceedingly simple from the mechanical standpoint, the cycle of operation is somewhat complex, tending easily to become unbalanced. On the other hand, the compression system is far more flexible from an operating phase, which is essential in most cases of gasoline manufacture where the load involved is anything but constant or steady. Very efficient operation can, therefore, be obtained from the compression machine, even without the use of highly skilled labor. For these reasons, and for the fact that the gasoline industry is already well acquainted with the gas compressor, the compression system of refrigeration is to be preferred as an auxiliary in the manufacture of natural gasoline.

With the decision that the compression method is the proper one to use in the gasoline industry, there is yet a selection to be made of the refrigerant to be employed. In spite of the fact that ammonia is a universally acknowledged material for this purpose, it should not be used in this instance because it is a substance totally foreign to the industry. Its use would, therefore, require additional education of the plant personnel. The refrigerant had best be a material made in the plant itself, or in other words, either the plant product or a byproduct derived from the major yield. In this way the refrigeration would be obtained independently of all outside sources, which in itself is an advantage.

The objection so often raised to the use of a hydrocarbon refrigerant is not valid here, since its use does not materially increase the fire and explosion risks over those already present in a gasoline refinery. While ethane, propane and butane vapors are highly flammable, they are non-corrosive to the materials of construction of the refrigerating system and do not decompose with continual use. Further, it appears from various observations that these hydrocarbons in moderate quantity (up to 50 per cent) as diluents of the atmosphere are wholly without the injurious and even fatal action associated with such irritant gases as ammonia and sulphur dioxide.

Although methane is probably the most common of the available hydrocarbons, condensation can be effected only at high pressures and low temperatures. The liquefaction of this component is comparable with the production of liquid air, and hence it may be eliminated from further consideration.

Ethane on the other hand has pressure-temperature relations very similar to carbon dioxide and is readily adaptable for use with carbon dioxide refrigerating machines.

Propane is the one hydrocarbon which has the best

Table I—Physical Properties of Common Refrigerants

	Name	Ammonia		Sulphur Dioxide		Methyl Chloride		Ethyl Chloride		Carbon Dioxide	
1	Chemical formula	NH_3		SO_2		CH_3Cl		C_2H_5Cl		CO_2	
2	Molecular weight	17.03		64.06		50.49		64.50		44.01	
3	Normal boiling point, deg. F.	—28.03		14.0		—10.65		53.9		—109.4	
4	Melting point (solid), deg. F.	—107.8		—103.4		—132.7		—217.7		—109.3	
5	Critical temperature, deg. F.	271.2		314.8		289.6		360.0		88.4	
6	Critical pressure, lb. abs.	1,651		1,141		970.0		784.0		1,071	
7	Density of liquid at 32 deg. F. (water = 1)	0.638		1.44		0.952		0.920		1.58	
8	Density of gas, lb. per cu.ft., 32 deg. F., 1 atm.	0.0517		0.1827		0.1438		0.2276		0.1234	
9	Density of gas at 32 deg. F. and 1 atm. (air = 1)	0.596		2.264		1.782		2.31		1.528	
10	Specific heat at constant pressure	0.520		0.511		0.24		0.273		0.2025	
11	Specific heat at constant volume	0.401		....		0.20		....		0.1558	
12	Ratio C_p/C_v	1.297		1.256 (16–34 deg.)		1.199 (68 deg.)		1.126 (63 deg.)		1.3003 (32 deg.)	
13	Comparative volume displacement per unit of refrigeration	1.0		2.61		2.01		6.41		0.17	
	Data at 5 and 86 deg. F.	5	86	5	86	5	86	5	86	5	86
14	Gage pressure, lb. per sq.in.	19.6	154	5.9*	51.8	6.2	80.8	20.1*	12.40	319	1,024
15	Volume liquid, cu.ft. per lb.	0.0243	0.0269	0.0108	0.0118	0.0163	0.0179	0.0169	0.0182	0.0163	0.0267
16	Volume vapor, cu.ft. per lb.	8.15	1.77	6.42	1.18	4.53	1.07	17.06	3.29	0.2673	0.0474
17	Density liquid, lb. per cu.ft.	41.1	37.2	92.0	84.4	61.0	55.8	59.0	54.88	61.22	37.41
18	Density vapor, lb. per cu.ft.	0.122	0.564	0.156	0.844	0.220	0.930	0.058	0.304	3.74	21.09
19	Heat of liquid, B.t.u. per lb.	48.4	138.9	14.11	42.12	21.2	59.3	—11.6	23.1	—13.16	45.45
20	Heat of vaporization, B.t.u. per lb.	565.6	492.6	169.4	142.8	178.5	162.9	177.0	162.6	115.3	27.00
21	Heat of vapor, B.t.u. per lb.	613.5	631.5	183.5	184.9	199.7	222.3	165.4	185.7	102.1	72.46

*Inches of mercury below standard atmosphere (29.82 in. = 14.686 lb. abs.).

range of temperatures and pressures for commercial refrigeration use. In many respects it closely resembles ammonia in its properties.

In a similar way, normal butane may be compared with ethyl chloride and sulphur dioxide, while isobutane resembles sulphur dioxide alone in its properties. Isobutane has been used with success as a refrigerant by several manufacturers of small household units.

In Table I will be found a comparison of the physical properties of the available hydrocarbons with those of the generally accepted commercial refrigerants. This table is based principally upon the data presented in Circulars No. 2 and 9 of the American Society of Refrigerating Engineers and on the "International Critical Tables."

Assume for the moment that the gasoline plant product is to be used as the refrigerant, and that it has characteristics similar to those of the product from the average absorption plant. In gravity it may possibly be 85 deg. A.P.I., with initial boiling point of 60 deg. F., and end-point of 370 deg. F. It undoubtedly will contain isobutane and the heavier members of the paraffin series, down to, and including, heptane. Such a product might be allowed to evaporate in the shell of an oil cooler, absorbing heat from the oil for this evaporation. The refrigerating compressor would then compress the vapor so evolved to the required pressure, whereupon it would be condensed and cooled, and the condensate again allowed to vaporize in the oil cooler. Once such a system was placed in operation, additional plant product would be required only as make-up for physical losses which might possibly occur.

A refrigerant of this nature is a blend of many hydrocarbons, resulting in a material having a wide boiling range, in this instance, one of 310 deg. Such material, when subjected to a definite evaporator pressure, will tend to assume equilibrium conditions between the fractions evaporated and those remaining in the liquid phase. This will result in a concentration of the heavier hydrocarbons in the remaining liquid, an effect which can only be avoided by operating the compressor in a manner to provide a low evaporator pressure sufficient to cause all of the refrigerant to volatilize. To do this would require a pressure materially lower than that required by any of the usual commercial refrigerants for a given evaporator temperature and would, therefore, result in uneconomical operation. It should be remembered that the refrigerants of the ice industry are of the single boiling point variety, the liquid being entirely evaporated at a single definite evaporator pressure.

To approach the conventional type of refrigerant more nearly, it is necessary to obtain a material with a much narrower boiling range than the average plant product. In these days of high butane extraction this is a simple matter, since such operation compels the use of a stabilizer. By taking excess reflux, even from an average stabilizing unit, a fairly good refrigerant may be obtained. The boiling range of such material is of the order of 100 deg. Such liquids are generally available at pressures above 160 lb. per square inch and have chemical compositions similar to the ones given in Table II.

By proper initial design of the stabilizing unit much shorter boiling range material can of course be provided, even to the point of producing a commercially pure single hydrocarbon. Such a hydrocarbon would have a boiling range of from 4 to 15 deg. F.

A second source for obtaining a refrigerant in the conventional gasoline plant is the residue overhead vapor from the stabilizer. This can be accomplished by compressing these vapors sufficiently to produce condensation with the available cooling facilities, and then venting from such condensate the dissolved vapors as well as the uncondensed vapors in equilibrium with the condensate. Such residue vapors are available at pressures in excess of 160 lb. per square inch and will have compositions similar to those in Table III.

Table II—Compositions of Several Stabilizer Refluxes

	Per Cent		
Sample	A	B	C
Methane	0.0	0.0	0.4
Ethane	9.7	4.8	2.8
Propane	38.1	93.8	78.4
I-butane	25.8	1.4	13.6
N-butane	24.4	0.0	4.8
Pentane+	2.0	0.0	0.0

Table III—Composition of Stabilizer Vent Gases

	Per Cent			
Sample	A	B	C	D
Methane	0.0	0.0	0.8	13.4
Ethane	4.6	7.9	9.2	45.5
Propane	61.9	81.2	70.4	37.0
I-butane	29.3	8.9	12.9	4.1
N-butane	4.2	2.0	6.7	0.0

Ethane	Propane	Normal Butane	Iso-Butane	
C_2H_6	C_3H_8	C_4H_{10}	C_4H_{10}	1
30.06	44.08	58.1	58.1	2
—126.9	—48.1	33.1	13.6	3
—277.6	—309.8	—211.0	—229.0	4
89.8	204.1	303.4	272.0	5
718.0	661.0	551.3	537.0	6
0.446	0.536	0.601	....	7
0.0846	0.1260	0.1619	....	8
1.049	1.562	2.067	....	9
0.397	0.365	0.351	....	10
0.324	0.361	....	....	11
1.224 (50 deg.)	1.153	....	....	12
0.30	1.01	2.20	....	13

Ethane 5	Ethane 86	Propane 5	Propane 86	Normal Butane 5	Normal Butane 86	Iso-Butane 5	Iso-Butane 86	
221	666	30.4	143	13.2*	26.9	3.3*	44.8	14
0.0365	0.0569	0.0291	0.0329	0.0260	0.0283	0.0268	0.0294	15
0.629	0.122	2.34	0.681	9.98	2.24	6.41	1.52	16
27.4	17.8	34.3	30.4	38.4	35.4	37.4	34.10	17
0.690	0.122	4.27	1.47	0.100	0.446	0.156	0.658	18
....	....	3.0	51.0	2.5	48.5	2.5	50.5	19
176	70	169.5	144.0	169.5	153.5	159.5	131.0	20
....	....	172.5	195.0	172.0	202.0	162.0	189.5	21

Comparison of Refrigerants

In one specific installation a compression refrigerating system was operated for cooling high pressure wet gas before introduction into the absorbers. The cooling of this gas from 118 to 85 deg. F. produced some condensate and resulted in a total refrigeration load of 1,387,600 B.t.u. per hour. The refrigerant used was produced from stabilizer overhead vapors. It had an initial boiling point of —50 deg. F., a final boiling point of 25 deg. F., and a Reid vapor pressure of 120 lb. per square inch absolute at 60 deg. F.

The liquid refrigerant was fed to the expansion valve at a temperature of 84 deg. F. and a suction pressure was carried which gave a temperature of 58 deg. F. in the evaporator. In the first column of Table IV will be found all of the operating characteristics of this system, and special attention is called to the composition of the refrigerant. Much of the methane and ethane in this refrigerant remained uncondensed upon cooling the compressor discharge vapors and hence were vented from the system. This venting entailed a loss of some of the heavier constituents as well, and as a result, fresh refrigerant had to be added to the system from time to time. It should also be noted for this mixed hydrocarbon refrigerant cycle that the computed compressor indicated horsepower was 91.2, and that this value is based on empirical data rather than on theoretical horsepower formulas. As a matter of fact, indicator cards taken from the compressor showed this horsepower to vary from 100 to 108, but it is felt that

Table IV—Comparison of Refrigerants for a Given Duty

(Refrigeration load, 1,387,600 B.t.u. per hour; temperature of refrigerant to expansion valve, 84 deg. F.; temperature required in evaporator, 58 deg. F.)

Refrigerant used	Mixed Hydro-carbons	Ammonia NH_3	Propane C_3H_8
Composition of refrigerant, mol. per cent			
Methane	7.97	....	....
Ethane	19.02	....	....
Propane	58.64	....	....
I-butane	9.78	....	....
N-butane	4.59	....	....
Sp. gr. refrigerant at 60 deg., 14.7 lb	1.435	0.587	1.523
Suction pressure, lb. abs., at 96 deg. F.	105	103.7	104
Discharge pressure, lb. abs	180	164	151
Gas volume compressed, std. cu.ft. per day	2,400,000	1,510,000	1,820,000
Refrigerant handled, lb. per hr.	10,755	2,830	10,070
Ratio of compression	1.71	1.58	1.45
Ratio of specific heats	1.164	1.29	1.153
Horsepower per million cu.ft. per day	38	35	29
Compressor indicated horsepower	91.2	52.8	52.8

this discrepancy is probably due to the inherent inaccuracies in the taking of such cards.

The system just described was considered very satisfactory by the owner, especially since it was assembled from material already on hand. It now affords a basis of comparison with single boiling point refrigerants, such as ammonia and propane. For purposes of comparison the ammonia is assumed available for evaporation at a temperature of 84 deg. F., the only other restrictions being that the evaporator must be held at 58 deg. F. and that 1,387,600 B.t.u. of refrigeration per hour must be produced. These conditions are identical with those met by the hydrocarbon refrigerant just described. The data for the ammonia cycle will be found in the second column of Table IV, and it is obvious that a considerable saving in compressor horsepower results. Actually, for the same refrigeration duty, the ammonia system requires but 52.8 i.hp. as compared with 91.2 for the mixed hydrocarbon refrigerant.

The comparison is further carried out by substituting propane for ammonia, the characteristics of the system being given in the last column of the Table IV. In this case, although more vapor must be handled by the compressor than in the case of ammonia, the specific heats and vapor pressure for propane are such as to result in the same compressor horsepower, namely, 52.8.

Thus for the same refrigeration duty the three refrigerants would require compressors as follows:

Hydrocarbon mixture,	100 hp. with 9 × 20-in. compression cylinder
Propane,	60 hp. with 8 × 20-in. compression cylinder
Ammonia,	60 hp. with 7¼ × 20-in. compression cylinder

The initial cost of such machines, taking the ammonia compressor as the standard, would be:

Ammonia compressor cost	1.000
Propane compressor cost	1.002
Hydrocarbon mixture compressor cost	1.330

Butane has not been given consideration in this comparison because it already has a use in the major plant product as a volatility agent. Propane has not. Under certain operating conditions it is possible to conceive that the butane fraction might work out to be an economical refrigerant for this class of service, but not in general.

From the discussion and figures presented it is concluded that for refrigeration in gasoline plants the use of a hydrocarbon mixture as a refrigerant cannot be justified in view of first cost. Such a system is further handicapped because approximately 75 per cent more fuel will be required than would be consumed in case either propane or ammonia were used. Between the latter two refrigerants there is little choice from the standpoint of either first cost or operating expense. Preference is given propane because it is readily available, or can be made so at little expense, at any gasoline plant. Any advantage which ammonia might have will be more than offset by the advantage which propane offers in that it can be produced locally as a byproduct of the main refining operation.

With such an excellent refrigerant so readily available there should be no further hesitation in its utilization for reducing the absorption reaction temperature to the order of 40 to 50 deg. F. By so doing, the cost of producing the major plant product can be reduced.

Producing High Vacuum With Rotary Pumps

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INCREASING demand for unusually high vacuum in commercial operations has been met in recent years by the use of oil-sealed, rotary-plunger type vacuum pumps. This type of pump produces a far better vacuum than the reciprocating or crank-and-flywheel types formerly used. Even the best double-stage reciprocating pump is unable to produce a vacuum such as is obtainable with a single-stage, oil-sealed rotary. The so-called clearance is reduced to zero in this type of pump and there is no air left in the cylinder or ports to re-expand. The price of a rotary pump is only a small fraction of that of a double-stage reciprocating pump having the same volumetric displacement.

Formerly, a vacuum within a few tenths of an inch of barometric pressure was considered excellent in commercial practice, but now many installations are operating at an absolute pressure of only a few millimeters, or a fraction of a millimeter, and some pumps, notably in the electric lamp and radio tube industries, are producing pressures of a few microns. Under these conditions some changes in operating technique are required, and there has been a demand for more convenient tables and charts covering data useful under high vacuum conditions.

The temperature and volume chart of Fig. 1 is based on the standard steam tables. It shows the temperature at which water evaporates or condenses at various degrees of vacuum. For example, at 29¾ in., water will boil at 40 deg. F. as indicated by the dotted line. When materials are dried under vacuum, if the available cooling water is above the corresponding temperature, no water will condense in the condenser and it will be necessary to pump out all the water in the form of uncondensed vapor. Much of the vapor, then, usually condenses in the pump and is removed by an oil clarifier, or it collects in a sump in the oil reservoir from which it can be drained off.

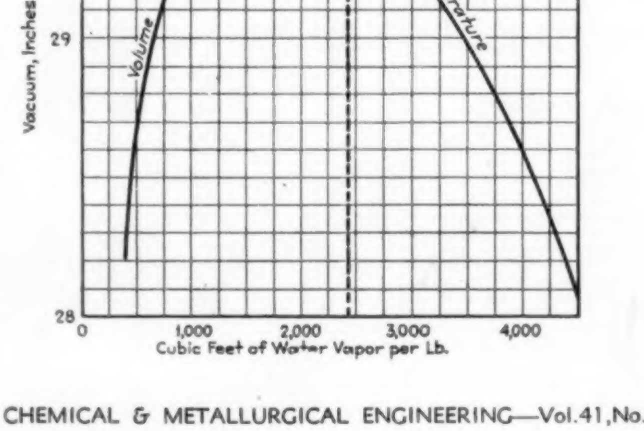
The volume of vapor which will have to be pumped, if not condensed, depends on the degree of vacuum and is also given by the chart. Time required to remove a definite quantity of water is found by multiplying the weight by the volume given on the chart and dividing by pump capacity and volumetric efficiency. For example, each pound of water at 29¾ in. has a volume of 2,420 cu.ft., and a 50-cu.ft. pump will, therefore, require 48.4 minutes to remove each pound at 100 per cent efficiency (see below), assuming that the necessary heat is available for evaporation. Actual operating time will be somewhat greater than this, as any air leaking into the system will increase the volume to be handled. Also the efficiency of the pump may be reduced by the evaporation of fine drops of water present in the circulating oil if these are not thoroughly removed. It is sometimes better to operate at a lower vacuum during the first part of a run so that the water can be readily condensed until most of it is removed, and then to pull the system up to high vacuum later.

Standard surface condensers are available in which a bypass valve is provided so that water already condensed may be prevented from re-evaporating when the high vacuum is subsequently produced.

Character of Oil Important

The choice of oil for sealing the vacuum pump is very important under high vacuum conditions. The oil should, of course, contain no readily volatile constituents. It should also be of such a nature that water will not readily emulsify with it. The water droplets produced by condensation in the pump should be readily removable before the circulating oil is returned to the interior of the

Fig. 1—Temperature and volume corresponding to vacuum



cylinder, for if not removed, the water will re-evaporate and reduce the volumetric efficiency of the pump. So-called "turbine oils" meet these conditions very well. For best results the circulating oil must be kept cool. This reduces re-evaporation within the cylinder of any condensation that may be present.

The thorough removal of condensed water droplets from oil has been very satisfactorily accomplished by the use of a small centrifugal clarifier through which all oil leaving the exhaust ports is passed before being returned to the oil reservoir. By this means a very high vacuum can be maintained over long periods without changing the oil. In the electrical field a drying process is now being performed at 300 microns, finishing at 100 microns, in a 22-hour period, using one of these rotary oil-sealed pumps equipped with a clarifier. Formerly a roughing pump and a finishing pump were used and a change of oil was required for each operating cycle. The time ran from 30 to 40 hours, or more, depending largely on the condition of the oil. The oil is now kept in good condition at all times and is never changed.

Fig. 2—Volumetric efficiency of typical oil-sealed and reciprocating pumps

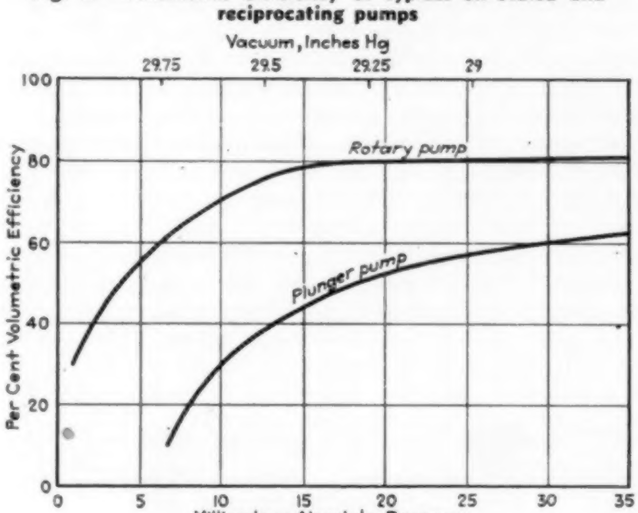
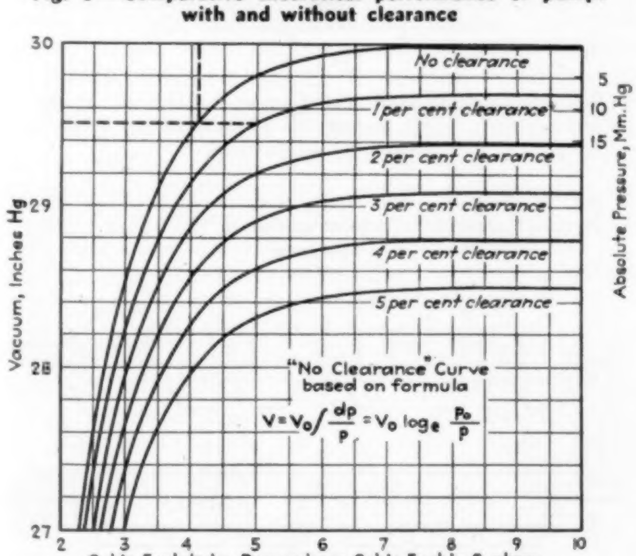


Fig. 3—Comparative theoretical performance of pumps with and without clearance



The efficiency of a rotary, oil-sealed pump will average around 80 per cent up to about 29 in. vacuum, dropping quite rapidly beyond 29½ in. At 1 mm. absolute pressure, efficiencies around 30 and 40 per cent are obtained. Length and diameter of pipe lines have a very marked effect on the performance at high vacuum. Typical efficiency curves for rotary oil-sealed pumps, and for reciprocating piston pumps, are shown in Fig. 2.

Fig. 3 shows clearly the comparative theoretical performance of the "no clearance" rotary, oil-sealed pump and the reciprocating type which always has some clearance at the end of the stroke. This chart also is useful in connection with calculations for the size of pump necessary for a given service requirement.

High Vacuum Calculations

To produce a given vacuum in any tight system, a certain volume of air must be pumped out. The volume to be pumped can be readily determined with the aid of Fig. 3 and the time required can then be obtained by dividing by the pump displacement and the volumetric efficiency.

Example. How long will be required to evacuate a 200-cu.ft. system to 29½ in. vacuum when using a 50-cu.ft. "no clearance" vacuum pump? Reading on the "no clearance" curve, the volume to be pumped per cubic foot is 4.09 cu.ft. The total to be pumped is, therefore, 200 times 4.09 or 818 cu.ft. Dividing by 50, the pump capacity, and 76 per cent efficiency (Fig. 2), gives 21.5 minutes.

Example. If the pump has 1 per cent clearance, how long will be required under the above conditions? Reading on the 1 per cent curve, the volume to be pumped per cubic foot is 5.0. The total volume to be pumped is 200 times 5.0 or 1,000. Dividing by 50 gives 20 minutes as the required time at 100 per cent efficiency, or 51.3 minutes at 39 per cent efficiency (Fig. 2).

If the pump has 2 per cent clearance, it will be impossible to obtain 29½ in. vacuum, the best obtainable in a tight system being about 29.4 in. as appears from Fig. 3. If the system is not tight or if vapors are being removed from objects in the system, a longer time will be required. For high vacuum work it is extremely important to reduce leakage to an absolute minimum. Even a very small leak will materially reduce the vacuum obtained. All pipe lines should be installed with the greatest of care, using sufficient luting compound on the connections, and the whole system should be painted with thick paint which will not crack on aging. Valve stuffing boxes should receive regular attention and gasket faces should be kept in pliable condition by the generous use of castor oil or other suitable sealing material.

Air leakage can be estimated by drawing the vacuum up to 28 or 29 in. and then shutting off the valve between the pump and the system and noting the time required for the vacuum to drop 1 in. The actual leakage of air measured at atmospheric pressure will then be 1/30 of the volume of the system. The rate of leakage, L, will be this figure divided by the time noted. The pump capacity, V, required to handle this leakage will be found by multiplying the leakage rate by the barometric pressure and dividing by the absolute pressure, P, to be maintained in the system.

Example. A 150-cu.ft. system dropped from 28 to 27 in. in 20 minutes. What pump capacity is required to maintain 29½ in. vacuum? 150 divided by 30 gives 5 cu.ft. leakage. The leakage rate is 5 divided by 20 or ¼ cu.ft. per minute. The required pump capacity will then be $\frac{1}{4} \times 30/0.5 = 15$ cu.ft. per minute. This must be corrected for the volumetric efficiency of the pump at the required vacuum.

WELDING in Chemical Industries

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Editor's Note—This is the first of two articles by Mr. Sandstrom on the design of welded joints for chemical plant equipment. The second article, to appear in an early issue, will discuss pipe and pressure-vessel joints.

IN THIS DISCUSSION of the art of fusion welding, good workmanship is presumed. That good work can readily be done has been demonstrated too often to admit of argument. That there have been instances of workmen sacrificing quality to quantity cannot be held against welding any more than the occasional excessive use of drift-pin and calking tool can be held against riveted work. That welding requires supervision is true. That riveted work requires supervision is evidenced by the presence of inspectors who scrutinize the work closely and who actually test rivets for fit and tightness by blows with a hammer.

The necessity for design in welded work is now generally recognized. The idea that welded work can be carried out entirely by the man handling the electrode or the torch is, or should be, as passe as the idea that riveted work can be designed by the man at the shear, the punch, the rolls or the riveter. The design of welded work is as much the province of the engineer as the design of riveted vessels or structures. And design should be followed by intelligent supervision and inspection.

In the absence of a practical and convenient method of testing welds in place, it seems that we must rely to a considerable extent on the conscientiousness of the welder. The bend test applied to coupons cut from welded plate is of value only in determining the ability of the welder, and has limited application to work going through the shop. The tests available partake more of the nature of a post-mortem than a diagnosis. The welder, however, knows when he is doing poor work, and persistence in the course denotes dishonesty or an unreasonable demand from his employer for a quantity production that is had at the expense of quality.

As the technique of welding is pretty well understood, and as the metallurgy of the subject is not a convenient tool to the everyday worker or manufacturer (who must rely on the materials and processes available), this discussion will be confined to what might be called the mechanics of welding. Inasmuch as the writer's observations have convinced him that the vast majority of weld failures have been caused by faulty design and not by poor welding, he deems such a discussion of greater moment than the somewhat academic one of micro-structure and metallurgy.

Second to a knowledge of mechanics as applied to welding comes knowledge of the metals that can be successfully welded and of their behavior under use. Fortunately, the most important metal is the most reliable when welded; namely, soft or mild steel. Soft steel is steel containing upward of 0.15 per cent carbon. In this class are found metals variously designated as soft steel, mild steel, wrought iron, ingot iron, etc. Soft steel is very ductile and lends itself to forming in dies as it will stand much bending without cracking. Boiler tubes are made of this class of steel. Boiler plate contains upward of 0.25 per cent carbon and is easily welded.

Structural steel contains upward of 0.35 per cent of carbon. Much satisfactory welding is done on this material, and the future will see welding preeminent in this field.

Steel containing more than 0.35 per cent carbon is designated "hard" steel. With an increase of carbon comes difficulty in welding, although steel containing 0.60 per cent carbon has been successfully welded.

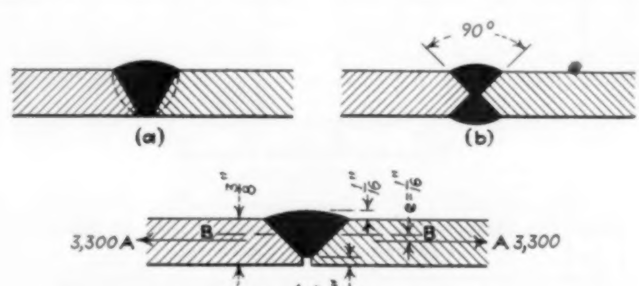
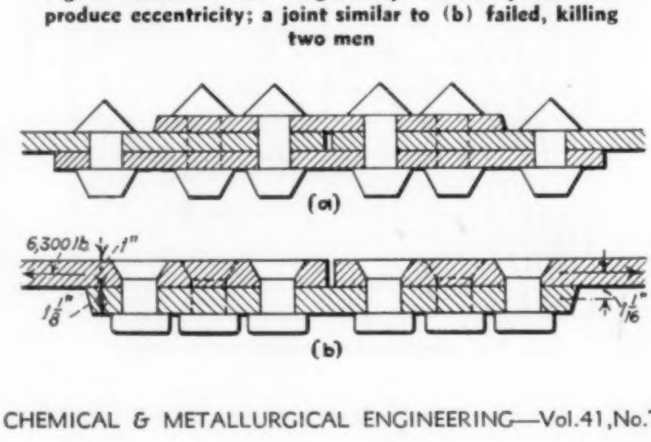


Fig. 1—Types of weld, including, at (a) and (b), single- and double-V welds, and at (c) an incompletely filled V, producing eccentricity

Fig. 2—Double- and single-strap riveted joints also produce eccentricity; a joint similar to (b) failed, killing two men



Tool steel containing upward of 1.5 per cent carbon is considered unweldable.

Cast iron contains 1.5 to 4.5 per cent carbon. It is welded with more or less success but is considered difficult material to deal with because of the uncertainty of the results. Proper preparation and expert workmanship produces excellent results, however.

While more than 0.6 per cent of carbon in steel renders it difficult to weld, some of the alloy steels containing more than 1 per cent carbon are successfully welded. Manganese steel containing 1.25 per cent carbon and 12.5 per cent manganese, and the so-called high-speed steel containing nearly 1 per cent carbon and 19 per cent tungsten have been successfully welded.

Nickel steel, chromium steel and chrome nickel steel containing upward of 0.4 per cent carbon are welded successfully.

That very interesting alloy, Stellite, is giving promise of wide use, thanks to the welding art. It can be applied to steel, bronze, brass and cast iron as a thin wearing surface, or edge, by a kind of "flushing," "sweating," or "tinning" process, and presents a surface that is extremely hard, its resistance to wear exceeding that of steel many times.

Copper can be welded successfully but this requires some skill. As it is a rapid conductor of heat, some trouble may be expected from this cause unless the article is preheated. Bonding of copper to steel is common but the result is neither strong nor ductile.

Brass is not a satisfactory metal for welding because the zinc is vaporized at the high temperature. Bronze, however, is welded satisfactorily and is much used for repairs of other metals and for replacing worn surfaces.

Aluminum is readily welded with either gas or arc, a flux or flux-coated rod being necessary to remove the oxide coating on the aluminum.

The subject of weldable metals is an extensive one and the reader will find much valuable information in the publications of manufacturers of welding equipment and wire.

Weld Types

The simplest kind of joint is the butt joint, in which the edges of the plates are merely brought together, or to within $\frac{1}{8}$ in., and welded. This joint, however, should be limited to plate up to $\frac{3}{16}$ in. thick, above which thickness the plates should be beveled, or scarfed. There are two kinds of beveled edge weld, known as single-V and double-V. In Fig. 1*a* is shown the single-V and in Fig. 1*b* the double-V welds. Of course, the figures are only conventional representations of welds. Actually, the metal of the plate is fused and the fused metal would have an outline about as shown by the dotted line of *a*. For the sake of convenience, however, the conventional representation will be used in this discussion.

When a single-V weld has proper penetration—that is, when the metal is fused to the plate to its full depth—it is quite a satisfactory weld. But sometimes the weld metal fails to fill the V completely, and the strength of the joint is impaired; not only because of the reduced area welded, but because of the eccentricity of the forces existing in the weld.

As shown in Fig. 1*c*, the line of stress in the plate is along A-A, and in the weld along B-B, producing the eccentricity *e*. The effect of this eccentricity is bending moment—a thing to be avoided if possible, but when not possible, provision should be made to resist it. A consideration of economy alone would condemn the single-V weld except in thin plate as it contains twice as much weld metal as a double-V of the same angle and, of course, produces a proportionately greater shrinkage in the work.

Assume the joint of Fig. 1*c*. The plate is $\frac{3}{8}$ in. thick; the allowable stress is 11,000 lb. per sq.in., and the efficiency of the joint is assumed as 80 per cent. The axial force is then $11{,}000 \times 0.375 \times 0.80 = 3{,}300$ lb. per lin. in. The weld is short $\frac{1}{16}$ in. of filling the V, so the eccentricity of the joint is $\frac{1}{16}$ in. The formula for the extreme fiber stresses under combined axial and transverse loading is $S = P/A \pm M\,c/I$, in which P is the axial force, in this case 3,300 lb.; A the area of the section, in this case $\frac{3}{8} \times 1 = 0.375$ sq.in.; M the bending moment, in this case $3{,}300 \times 0.0625 = 206$ in. lb.; I the moment of inertia of the section, or $1 \times 0.375^3/12 = 0.00439$ in.^{4}; and c the distance from the neutral surface to the extreme fibers, or 0.1875 in. Substituting and solving, we have $S = \dfrac{3{,}300}{0.375} + \dfrac{206 \times 0.1875}{0.00439} = 8{,}800 + 8{,}800 = 17{,}600$ lb. per sq.in. It is thus seen that an eccentricity of one-sixth the width of the section doubles the maximum fiber stress. Many occupants of cemeteries had their change of residence effected by the aid of eccentric loading of structures and apparatus of one sort or another.

Lessons From Riveted Joints

Eccentricity exists also in most riveted boiler joints. In the conventional double butt-strap joint, of which Fig. 2*a* is an example, the inner strap is wider than the outer and contains more rivets. The result is a joint made eccentric by this disposition of rivets. This joint presents too many unknown factors to be analyzed easily, but it is evident that the outside single-shear rivet carries a very large stress and that because of the lack of symmetry, there is an eccentric loading that introduces transverse or bending stresses. This sort of joint, which has been accepted as the *ne plus ultra* by many engineers, gives point to the insistence on ductility of plate in steam boiler practice. When its devotees view with alarm the growing practice of welding, we wonder at the faith which is in them. For it is in the distribution of stresses in welded—not riveted—joints that there are few mysteries.

A particularly atrocious example of eccentricity in a riveted joint appears in Fig. 2*b*. This joint, in a 15-ft. diameter tank in a chemical plant, failed a few years ago, resulting in the deaths of two men, and injuries to several others. With a hoop stress of 6,300 lb. in the tank at the operating pressure of 70 lb. per sq.in., and a joint eccentricity of $1\frac{1}{16}$ in., calculation shows the combined stress under axial and transverse loading to be in the neighborhood of 53,650 lb. per sq.in. along the rivet holes in the strap. As this is nearly the ultimate strength of the material, it is remarkable that the apparatus had been in use for 20 years at the time of failure, a fact for which thanks are owing to the adjustment that must have taken place by yield of the metal. Failure, of course, was caused by oft-repeated flexure.

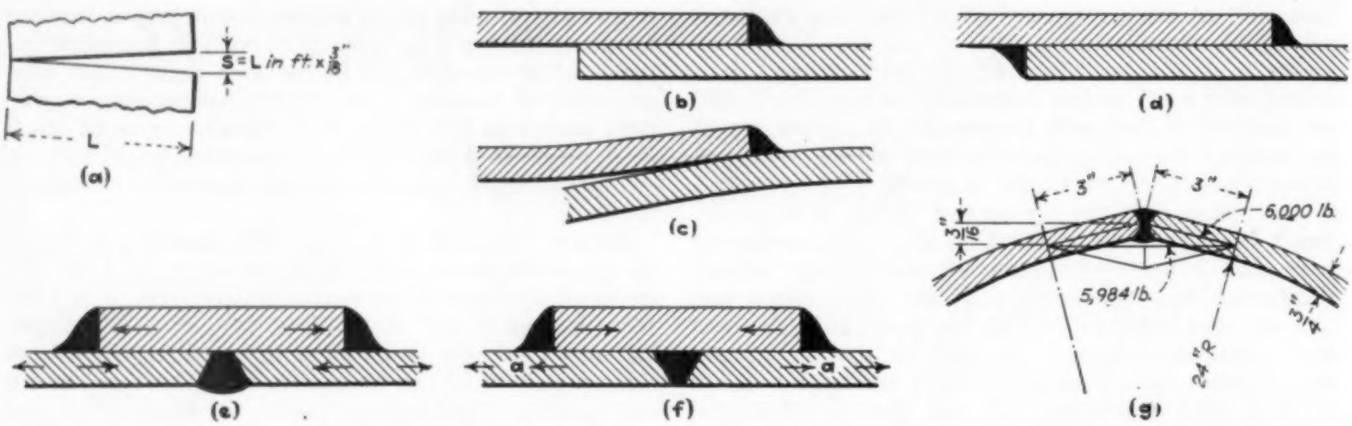


Fig. 3—(a) Proper divergence of plates in welding; (b) and (c), showing what happens in a single-weld lap joint; (d) satisfactory type of lap joint; (e) and (f), examples of butt-joints for pressure vessels, which introduce eccentricity but may be justified because of the rigidity they supply; (g) showing forces in a cylinder joint when the ends are tangents

Welded Joints

In welding long seams the edges of the plates should be made to diverge about $\frac{3}{16}$ in. per foot, as illustrated in Fig. *3a;* this in order to counteract the tendency of the plate to close and lap with the shrinkage of the weld on cooling.

The lap joint with a single weld shown in Fig. *3b* is very inefficient. Under tensile stress it tends to assume the shape of Fig. *3c*, putting a tearing stress in the weld. Were the inside edge merely tack-welded it would prevent the joint opening, thereby reducing the tendency to tear, and greatly increasing the efficiency of the joint. A better joint is shown in Fig. *3d*. The principal objection to the lap joint is the eccentricity of the axes of stress.

The butt-V-and-strap joints shown in Figs. *3e* and *f* are in common use in pressure vessels. Where it is impossible to weld from the inside of the vessel, the shell plates may first be single-V welded from the outside, the weld ground down smooth and the strap welded as shown in Fig. *3f*. The method shown in Fig. *3e* produces a somewhat stronger joint because the strap is joined to the shell by three welds.

These strap joints, although they give much comfort to people who associate strength with mass, are not as strong as the joint shown in Fig. *1b* because of the eccentricity introduced by the strap. In large tanks made of thin metal, however, the strap provides a rigidity at the joint that probably justifies its use.

In making the strap joints of Figs. *3e* and *f*, the question arises: Which weld should be made first; the one joining the shell plates or the two at the edges of the strap? Let us assume that the shell joint is made first, as is necessary in the case of Fig. *3f*. If the welds along the edges of the strap are then made simultaneously, the shrinkage effect is a maximum, so it probably is best to weld first one edge and then the other.

When the final weld on the edge of the strap cools, the shrinkage force is resisted by compressive reactions in the length a-a of Fig. *3f*, the direction of the forces indicated by the four inside arrows. When pressure is applied to the vessel, producing tensile stresses in the plate, these stresses act away from the joint as indicated by the outside arrows, the latter being added to the shrinkage reaction under the strap. The sum of these forces may exceed the shearing strength of the weld at the edge of the strap and cause it to open. The result is that the strap is rendered useless and the joint is then equivalent to a single-V.

By first welding the edges of the strap and then the ends of the plate, the forces act as indicated by the arrows in Fig. *3e* and the shrinkage stress, or the stress beyond the strap, whichever is the lesser, is subtracted from the other. The result is a lower shearing stress in the strap welds, and all welds contributing to the resistance of the joint.

When a strap is used on a joint the outside welds should be made first and then the inner one. And the designer should be mindful of the fact that in order to keep the maximum bending stress equal to the direct tensile stress in the plate, the strap must be not less than three times the thickness of the plate—a fact that should assist in eliminating single butt straps altogether, because their usefulness is more apparent than real. If a fraction of the cost of a single butt-strap were applied to the plain butt joint shown in Fig. *1b*, the result would be a first-class joint, free from bending moments.

Effect of Tangents in Cylinders

Sometimes the ends of the plates of circular pressure vessels are short tangents; that is, they are not circular, a fact which causes very high transverse stresses. A strap welded over the joint as in Figs. *3e* and *f* would, by the added thickness, assist in resisting the stresses that would arise.

Assume a pressure vessel 48 in. in diameter. The working pressure is 250 lb. per sq.in. With a working stress of 11,000 lb. per sq.in., and a joint efficiency of 80 per cent, the thickness of plate is $48 \times 250/2 \times 0.80 \times 11{,}000 = 0.682$ in., say $\frac{11}{16}$ in. or 0.6875 in. Assume also that the ends of the plate are not circular but have tangents 3 in. long as shown exaggerated in Fig. *3g*. The tangential force per inch of length of shell is $250 \times 48/2 = 6{,}000$ lb., which is one side of the force parallelogram, or the hypothenuse of the force triangle. The tangential force of 6,000 lb. may be re-

solved into two forces, one chordal and the other radial. Multiplying the chordal force by the short side of the triangle, or the eccentricity, we have the bending moment in the joint, or $5,984 \times 0.1875 = 1,120$ in. lb. Solving for the extreme fiber stress by the equation for combined stress we have $f_s = 6,000/0.6875 + 1,120 \times 0.3438/(0.6875^3/12) = 8,725 + 14,250 = 22,975$ lb. per sq.in. With a 36-in. shell and the same length of tangents, the extreme fiber stress is about 30,000 lb. per sq.in.

In addition to being very high, the foregoing stresses occur at the joint, which may not be perfect. Furthermore, every variation of pressure in the vessel produces flexure and thereby shortens the life of the joint. Every effort should be made to obtain truly circular shells for pressure vessels.

Fillet Welds

A fillet weld is shown in Fig. 4*a*. This kind of weld is used in connecting nipples to pipes and tanks, and the shells of heat exchangers to their tube sheets. As commonly made it contains too much weld metal. The welder is prone to associate a large mass of weld metal with strength and he frequently builds up a fillet similar to *b*. Failure of the joint may occur by breaking the plate along A-A which, however, is unlikely as is failure along B-B. Rupture of the weld is most likely to occur along D-D and up to C. In the case of a pipe or other pressure vessel, opening of the weld along D-D increases the area under fluid pressure and increases the eccentricity and consequently the stress in the weld, so

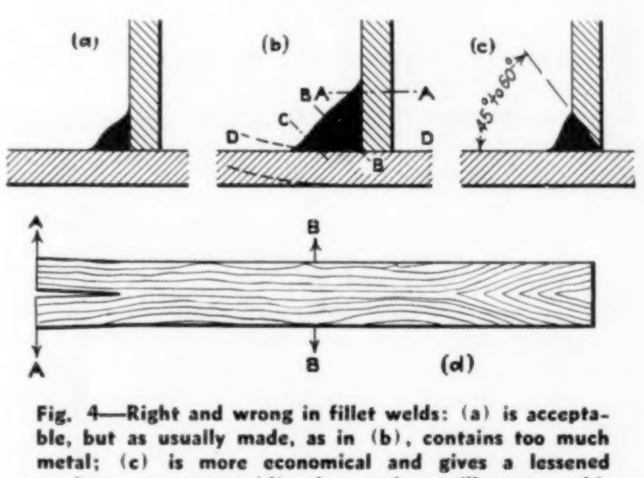
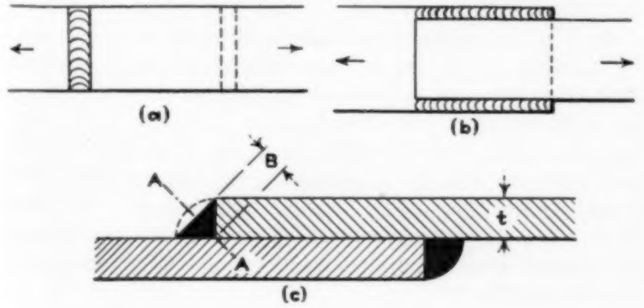


Fig. 4—Right and wrong in fillet welds: (a) is acceptable, but as usually made, as in (b), contains too much metal; (c) is more economical and gives a lessened tendency to tear; (d), by analogy, illustrates this lessened tendency

Fig. 5—(a) and (b) show end and side welds while (c) illustrates the effect of weld shape in an end weld



that failure is a progressive tearing. Increasing the size of the fillet would merely delay rupture. Another objection to wide fillets is that when applied to tube sheets or flanges, the large shrinkage in cooling dishes the sheet or flange as indicated by the dotted lines.

A more economical weld is that shown in Fig. 4*c*. A direct tensile stress is carried by the weld with a minimum tendency to tear.

The importance of avoiding tearing stresses may be strongly impressed on one's mind by a consideration of the force required to split a board. It is evident from an inspection of Fig. 4*d* that the force required at A-A to split the board is much less than the force required at B-B and, once the crack is started, the leverage afforded by the open crack easily and quickly splits the board to the end.

There is little justification for the weld of Fig. 4*a*. Plate can be beveled by means of bevel shears at no extra cost, and pipe or pipe nipples can be beveled in the lathe, or with a special cutter, at a fraction of the cost of the added weld metal in a joint of type *a*. Of course, the welder prefers the square corner to the notch formed by the bevel, but if improvement in the industrial arts must consider personal preferences of workmen, then progress may as well take off its hat and sit down. A good welder can completely fill a 45 to 60-deg. V with weld metal, and considering the importance of keeping forces concurrent (that is, in line), all connections of this kind should be made with a bevel such as that shown at *c*.

End and Edge Welds

Frequently plate and structural shapes are welded by means of end or edge welds or both. In Fig. 5*a* is shown an end weld and at *b*, an edge weld. With equal amounts of weld metal the method of *a* would be the stronger because the stress is distributed uniformly along the weld. In Fig. 5*b* the stress is a maximum at the ends and decreases progressively to the middle because of the elasticity of the material. In this respect it is analogous to lapped riveted joints.

Fillet welds tested to destruction generally fail along the line A-A shown in Fig. 5*c*. The area at A-A is then a measure of the strength of the joint. If the slope of the weld is 45 deg., then the thickness B along A-A is the sine of the angle 45 deg. or 0.71; and the strength of the weld would be the thickness t multiplied by 0.71 and by the strength of the weld metal. By building the weld up to the thickness indicated by the dotted arc, the maximum strength would be attained. This would be t multiplied by the strength of the weld metal.

The strength of the weld metal in the foregoing case may safely be assigned as 10,000 lb. per sq.in. for the area B which, for a 45-deg. slope, would amount to 7,100 lb. per sq.in. in terms of the thickness t. By building up the weld to the dotted arc the strength may be taken as 10,000 lb. per sq.in. in terms of the thickness t. These values are one-fourth to one-fifth of the ultimate strength of the welds.

In the transition from riveted to welded work it is convenient to know what strength values to assign to fillet welds in terms of the common sizes of rivets. The table on the next page shows the lengths of various thicknesses of fillet welds that tests have proved to be equiva-

lent to standard rivets. The allowable shearing strength of the rivet is 10,000 lb. per sq.in. and the driven diameter is $\frac{1}{16}$ in. greater than its nominal size. An advantage of the welded joint, however, is that the stresses between plates are more uniformly distributed than in the case of rivets.

A plug weld is shown in Fig. 6*a*. It is made by welding two bars together through a hole in one of them.

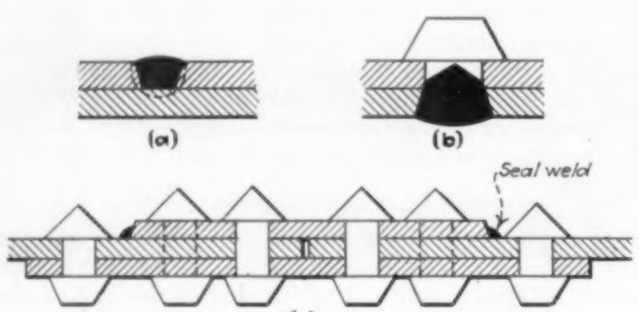


Fig. 6—Plug and calking welds: (a) simple plug weld for attachment of wide bars or sheets; (b) calking a loose rivet; (c) weld for calking a seam; such a weld becomes a structural element contrary to usual belief

The hole is preferably countersunk as a convenience to the welder. When a bar or sheet is so wide that the edge welds shown in Fig. 5*b* are not sufficient to develop its strength, then plug welds may be used. They can be figured in the same manner as rivets, but unlike a riveted joint, there need not be deducted the full amount of metal represented by the hole in the plate since this is replaced by the weld metal.

Calking Welds

A calking weld is a weld intendede to prevent leakage through joints, rivets, pipe connections, etc. Where a rivet is so loose that it must otherwise be replaced in order that its strength may be preserved, the head may be removed, the shank drilled out, the hole tapered and filled with weld metal as shown in Fig. 6*b*. At present,

Lengths of Fillet Welds Equivalent in Strength to Rivets

Nominal Diameter of Rivet, Inches	Driven Diameter of Rivet, Inches	$\frac{1}{4}$-In. Fillet Inches	$\frac{5}{16}$-In. Fillet, Inches	$\frac{3}{8}$-In. Fillet Inches
$\frac{1}{2}$	$\frac{9}{16}$	1	$\frac{3}{4}$	$\frac{3}{4}$
$\frac{5}{8}$	$\frac{11}{16}$	$1\frac{1}{2}$	$1\frac{3}{16}$	$1\frac{1}{8}$
$\frac{3}{4}$	$\frac{13}{16}$	2	$1\frac{5}{8}$	$1\frac{3}{8}$
$\frac{7}{8}$	$\frac{15}{16}$	$2\frac{3}{4}$	$2\frac{1}{4}$	$2\frac{1}{8}$
1	$1\frac{1}{16}$	$3\frac{1}{2}$	3	$2\frac{3}{4}$

boiler codes do not permit this kind of repair, but it can readily be seen that it is as good as a rivet since the hole is completely filled; furthermore, the weld metal, being fused to the plate, replaces the metal removed by the drill, and, of course, increases the efficiency of the plate thereby.

It is frequently proposed to calk a leaking seam in a riveted joint by means of a small bead of weld metal as shown in Fig. 6*c*. The general impression is that, as the rivets are the structural elements, carrying the loads, the weld assumes no other function than preventing leaks. In view of the fact that the outer rivets of such joints take a greater share of the load, it is clear that the weld in this case, because of its position in the line of stress, will assume as much load as its elasticity will permit. Seal welds should, therefore, be regarded as structural elements.

Sheet Steel

"Sheet" steel is the designation of flat steel up to $\frac{3}{16}$ in. in thickness. Much work in sheet steel can be done by merely fusing together with a torch corners or projecting edges as shown in Figs. 7*a* and *b*.

Lacking the necessary rigidity, some kinds of welding in sheet steel may result in a warped product, so preheating and annealing may sometimes be required to produce good results. In many cases, however, slightly warped surfaces are unimportant and no attempt is made to avoid them. Warping is most likely in the case of flat surfaces, since cylindrical or spherical surfaces possess an inherent rigidity that resists the tendency to change shape.

Until the advent of fusion welding, the flat sides of tanks or vats were stiffened by channels, Z-bars or angles riveted to the plate. Fig. 7*c* shows the commonest type of stiffener—an angle riveted to the plate. To be most effective, the angle should be on the outside of the tank since in this position the extreme fibers of the outstanding legs are in tension and there is no tendency to buckle. When, for the sake of appearance, the stiffener is placed on the inside of the tank, the extreme fibers of the outstanding leg are in compression, and the angle

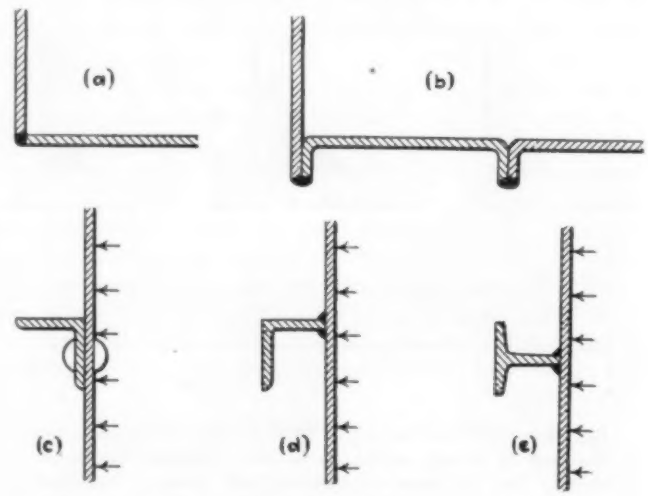
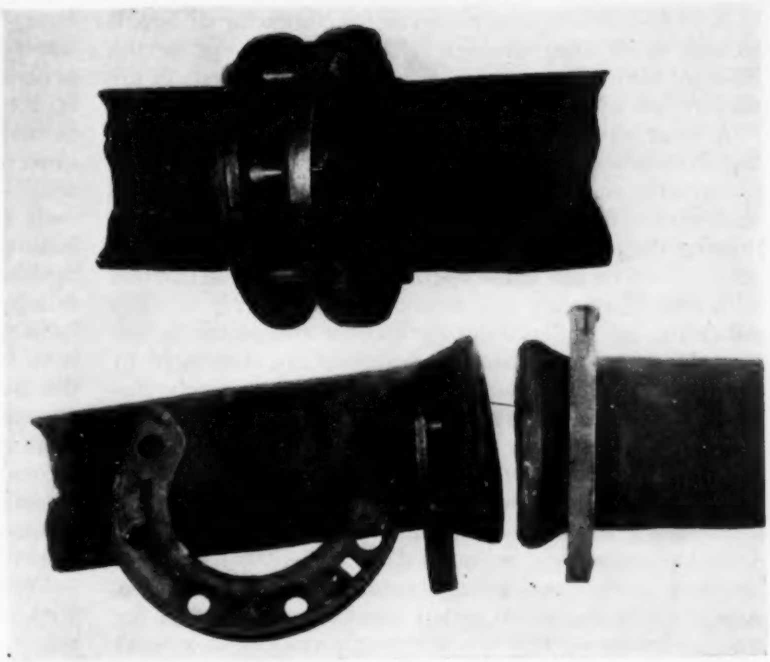


Fig. 7—(a) and (b), Sheet steel joints; (c), (d) and (e), stiffeners for sheet steel tanks

will fail by buckling even when under a comparatively light load.

In Fig. 7*d* is shown an angle stiffener made possible by welding. One leg is tack welded to the side of the tank, the other leg forming a flange that is very effective in resisting transverse stresses. A $3 \times 3 \times \frac{1}{4}$ in. angle, together with a 12-in. width of $\frac{3}{16}$-in. tank plate welded as shown at *d* is three times as resistant to the liquid pressure as the riveted arrangement of *c*. A tee as shown at *e*, having a symmetrical section, is stressed more uniformly than an angle and for that reason is preferable as a stiffener.

A hose joint designed as a substitute for nipples and flanges, and in most cases is lower in cost. It affords a perfect seal in all suction service and discharge service up to 125 lb. working pressure



Rubber Acid Hose For Process Industry Service

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SINCE the early days of chemistry the problem of satisfactorily conducting corrosive liquids, where utmost flexibility was of paramount importance, has been a stumbling block in otherwise practical processes. This problem, in fact, has not been entirely eliminated as yet, but much has been accomplished.

When rubber first became commercially available, it was heralded as a long-sought-for relief and many attempts were made to use it as a flexible conductor and as a corrosive-resistant lining for chemical storage equipment. However, the fact was soon established, mainly through trial and error, that this unvulcanized rubber was not particularly satisfactory. Changes in physical characteristics due to temperature variations alone were excessively inconvenient. True, some lining is still done with unvulcanized rubber, but in the great majority of cases a decided improvement is effected in such matters as discoloration, gaseous diffusion, and elimination of odor or taste to the material being conducted, by using a vulcanized rubber, combined or compounded before vulcanization with the necessary reinforcing materials.

The use of other materials than rubber in a rubber composition for corrosive service is not an attempt to produce an elastic product with the idea of using the least rubber possible, but is, rather, an honest effort to produce the best material for the proposed service. While it has been quite impartially established that true hard rubber products in general resist the action of corrosives, not abrasives, to a higher degree than soft rubber, hard rubber in hose construction is limited to nipples, flanges, and other connections. Except for these applications soft rubber compounds are preferred because of their flexibility.

One of the principal assets of acid hose is its flexibility. It can easily be erected. It can easily be replaced. It can be used in services which are of a temporary nature, where it would be considerably more expensive to install a more permanent liquid conductor. Again, many operations in chemical plants (dye plants, for example) are changed quite frequently, and it is far less practical to delay operations for the construction of a permanent conveyor when a length of acid hose will perform satisfactorily.

Acid hose can readily be thrown over the side of a vat or process tank and used to syphon the liquid from the container into another, or to convey it to waste. And, if there are not too many plies of fabric used in the construction of the hose, the syphon need not be broken; it can be interrupted simply by the use of a pinch clamp, although this procedure has a tendency to weaken the hose at a clamped section.

Although bottom outlets on tanks are not recommended, hose is often used to transport corrosives by gravity from one vessel to another. In this service as well as in any other where hose is used, it can readily be seen that building rafters, beams, or other obstructions interpose no difficulty to the use of this flexible conductor. It is a simple matter to direct the hose around such obstacles and not even the simplest drawing or layout is required to guide the installation.

Acid hose is frequently used as the conductor of liquids to and from filter presses. Here again its properties of flexibility, ease of erection, and ready replacement are decided advantages.

A most modern and economical method of transporting corrosives such as commercial hydrochloric acid, phosphoric acid, and ferric chloride, is in rubber-lined tank cars. This creates, of course, the problem of conducting the acid to the tank cars and emptying it at the point of delivery. These operations can easily be handled with either ordinary acid hose or acid suction hose. The difficulties of undertaking permanent constructions for these loading and unloading operations are eliminated by using hose. Furthermore, the hose can be quickly disassembled from the fittings on the tank car or storage tank and placed under shelter until the next time it is to be used.

It is commonly known that soft rubber is an excellent material for resisting abrasion. This, added to its other desirable properties, makes it an excellent material for handling corrosives which contain abrasive particles. Acid hose is therefore widely used in glass plants for conducting rouge which is frequently present in a weak solution of sulphuric acid. In one of the major chemical plants in this district, a length of acid hose is being used to convey liquor and crystals from a central feed tank to four centrifugals. Hose is easily the most economical medium for performing this task.

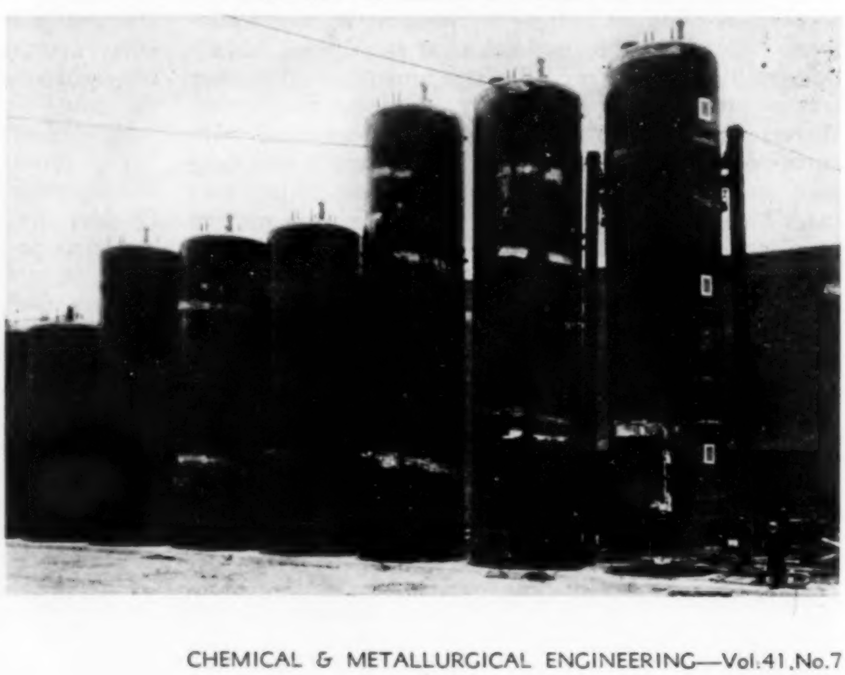
Again, a number of chemical plants require the transport of acid to various units and floors by means of truck tanks. A small air compressor is usually provided to force the acid from these trucks through lengths of hose to the desired location. When not in use the hose is coiled in the back of the truck and is out of the way. Another use of acid hose is to exhaust gases where acid fumes are present in a plant. And, of course, the availability of a length of hose when it becomes necessary to take out of service temporarily a permanent pipe line because of a leak or faulty valve, or other difficulty, has prevented many an otherwise very costly shut-down.

Because installed primarily on account of its flexibility, acid hose is often subjected, through carelessness or ignorance to far more rigorous treatment than was originally contemplated. For instance, a line is designed and installed to handle very low, positive—slightly above atmospheric—pressures, and considerable negative pressure or vacuum. The rubber parts being soft would readily collapse unless reinforced. Reliance for support against vacuum is placed, therefore, on metal, incorporated usually in the form of wires in the hose wall, either as a helical coil or as a braid. Yet such a hose can be, and often is, broken down early in its life through "kinking" (bending to so short a radius of coil as to cause the reinforcement to take a permanent set), or by subjecting it to a pressure which does not appear excessive, but is far beyond the calculated working strength of the hose. In either case, if failure does not occur immediately, the rubber parts, subjected to the corrosive action while under tension, develop cracks and the hose is unnecessarily condemned. Again, failure of a hose is many times due to the couplings, even though the observed break is some distance removed from the fitting. If the outside diameter of the coupling is excessively large for the inside hose diameter, damage to the hose tube may occur in insertion. Even if the tube is applied without scarfing or rupturing, a tension strain is set up in the entire carcass at the nipple which will have the same deleterious effect as takes place when the hose is kinked. Then, as soon as the tube is permeated, the liquid can travel down the reinforcing carcass to appear at an apparently distant and wholly unrelated point. A somewhat similar type of failure which is common may be traced to a constant bending taking place directly at the end of the nipple, allowing it to cut through the tube or develop tension cracks for the penetration of the liquid.

Peculiar as it may seem it is generally better not to flush out a hose for corrosive liquids with water, either hot or cold. Aside from the possible handling danger, such a practice is actually detrimental to the hose. The common assumption that rubber is "waterproof" is, like most popular opinions, not strictly accurate. Under proper conditions, such as distilled water, slight pressure, or heat, it can be shown that absorption of water in a given rubber is of greater magnitude than is that of almost any of the commercially handled chemicals. For example, if wash water is not positively drained by hanging a hose length vertically until dry, small pools containing a more or less corrosive contamination will lie against the inside rubber coating or tube. Local swellings will be caused which can be still further aggravated by the corrosive when the hose is again put in use. Prolonged exposure to water and then the sudden presence of a concentrated inorganic acid may result in a "puffing" of the inner rubber surface.

A well-balanced hose properly installed and reasonably

Hydrochloric acid is removed from these 47 ft. tanks by air pressure through specially constructed rubber hose



handled can be constructed which, with the exception of ammonium persulphate which is limited to 100 deg. F., will successfully handle almost any chemical up to a maximum temperature of 150 deg. F. (For a list of chemicals that rubber will resist see *Chem. & Met.*, Vol. 39, p. 264, 1932.)

In the majority of installations where internal pressure is created by gravity flow which rarely exceeds 30 lb. gage pressure, and the hose is given intermittent service, being allowed to drain or otherwise be relieved of pressure between periods, a hose having from $\frac{1}{8}$ to $\frac{3}{8}$ in. thick tube wall, three to six plies of bias-laid cotton fabric and from $\frac{1}{16}$ to $\frac{1}{8}$ in. thick cover wall will be satisfactory. In all cases the ends of the hose must be adequately covered or capped to prevent possible deterioration of the reinforcing fabric, even if the hose end itself is not to be immersed in the liquid.

Where, on the other hand, the external pressure is greater than the internal, through suction being applied to the hose or an external weight having a greater unit pressure than the internal pressure exerts, the wall must be supported. A customary construction consists of a rubber tube from $\frac{1}{8}$ to $\frac{3}{8}$ in. thick, an open-mesh cotton fabric, a layer of rubber, one or more bias-laid plies of cotton fabric, a layer of rubber with a helical coil of wire embedded therein, one or more plies of bias laid cotton fabric, and a rubber cover of from $\frac{1}{16}$ to $\frac{1}{8}$ in. thick. In addition to these two basic constructions there are, of course, others for specific services with minor alterations in the disposition of the materials.

Some of the unusual installations, proving that hose is adaptable for more than its accepted, prosaic task of serving as a connector between two movable or one fixed and one movable point, may be of interest.

It was desired to vent a rotating cylindrical drum containing a corrosive liquid. Connection was made through the center of the head to the variable surface of the liquid by a rubber hose, the end of which was held above the surface by a suitable float. As the drum turned, the hose turned, but did not twist nor kink since the surface float was rotated by the torque from the hose.

Bottom outlets are considered dangerous for tanks handling corrosives and for that reason the acid had to be removed by air pressure from two large vertical rubber-lined muriatic storage tanks approximately 47 ft. deep. Due to the length of the eduction pipe required, rubber-lined and rubber covered metal pipe could not be used. A hose sufficiently heavy to sink in the liquid, even though empty, was made up for use as the eduction pipe. Metal wires were incorporated lengthwise in the hose to handle the end strain produced by its weight and to prevent stretching, and the installation proved successful.

A new hose joint shown in an accompanying illustration which eliminates all contact between metal and fluid has recently been developed. This construction is said to permit greater flexibility than any other type of coupling or joint and affords a perfect seal in all suction service and discharge service up to 125 lb. working pressure. The Flexseal joint is designed particularly as a substitute for nipples and flanges—and in most cases is lower in cost. It is recommended particularly for the larger diameters of suction or discharge hose handling abrasive materials and hose handling acid or other corrosive liquids.

The success of the joint is dependent on the unique end which is built into the hose. This end consists of an enlargement, or bead, reinforced with numerous plies of fabric surrounding a rigid steel ring of angular cross section. The joint is assembled with the aid of split flanges and standard bolts. Two successive lengths of hose can thus be bolted together with the rubber ends of the hose compressed to form a seal.

The spacing of the bolt holes is standard so that the end of the hose can be fitted to the end of a standard pipe. When the bolts are drawn up the pressure of the split flange against the flared hose end provides a positive and unyielding clamping of the joint.

Applying Rubber Coating To Equipment

ONE of the major advances of recent years in connection with protection by rubber has been the discovery of new methods for increasing the firmness of attachment of rubber to other surfaces, particularly iron or steel as Dr. D. F. Twiss pointed out in a paper read before the Society of Chemical Industry in March. Most of these methods are effective with soft-rubber coatings, whether formed *in situ* by a latex process or applied as unvulcanized sheet. A prime coating of ebonite or ebonite solution on the prepared metal has often been applied as an effective method for securing increased firmness of attachment of a soft rubber sheet coating. A solution of rubber, containing a high proportion of *p*-nitrosodimethylaniline, applied as a first coating also ensures greatly enhanced strength of adhesion. Hæmoglobin has been used, mixed with rubber in a primary adhesive layer.

Another method is the coating of the steel foundation with a film of brass or other copper alloy which becomes attached more firmly to the rubber. More recently this has been elaborated into the use of a preliminary application to rubber or metal of a solution of a metallic compound, *e.g.*, a copper soap, one part of the molecule of which provides firm attachment to the steel and the other to the rubber.

A further advance has been to render the rubber itself capable of stronger adhesion. This has been done, *e.g.*, by acting on the rubber surface with a halogen or halogen compound before application to the steel. A more satisfactory method has been to use a mixture of natural resins and rubber. When a soft-rubber compound is vulcanized in contact with a steel plate which has first been painted with a solution of an adhesive of this class, the bond between rubber and metal can be actually stronger than the rubber itself. At 100 deg. C. the attachment is weakened, and a maximum temperature near 70 deg. C. is advisable.

As an alternative to attaching rubber to metal it is possible sometimes, *e.g.*, in concrete structures to provide a special suitable surface to support and hold the rubber lining. The special surface (for tanks of concrete, wood, and even metal) conveniently consists of a hydraulic cement to which latex has been added with or without rubber crumb. The cement holds itself to the foundation on which it is spread and the exposed rubber particles on its surface provide anchorage for the rubber sheet which is subsequently applied.

Solution Cycles for Power and Process Use

EDITORIAL STAFF REPORT

SINGLE COMPONENT working fluids for heat cycles, such as water or mercury for power generation, and ammonia or sulphur dioxide for refrigeration, are generally recognized in engineering practice. But the use of solutions of two or more components in operations involving the separation and re-solution of the components is limited in practice almost exclusively to the ammonia-water absorption cycle. Absorption cycles using solutions of many kinds offer a most interesting and promising field of investigation, according to a paper presented under the title of "Solution Cycles" by William H. Sellew of Ann Arbor, Michigan, at the New York meeting of the American Institute of Chemical Engineers, May 16, 1934. (In the limited space available here it has been possible to touch only on some of the most interesting phases of this development. Readers who require further details should refer to the original paper, which will appear in Vol. 30 of the Institute's *Transactions*. EDITOR.) Because of the wider range in properties of solutions and because of the additional variations of process that are thus made possible, over single component working fluids, results otherwise impossible can be attained. The chemical engineer's domain is ever expanding and promises to include heat and power engineering if solutions are employed for these purposes.

As early as 1810 the absorption of water vapor in strong sulphuric acid was used in a refrigeration process. The first absorption process for power production dates to 1869 when Spence passed exhaust steam into a saline solution, raising the solution to its own boiling point. During the 80's, Honigmann built several fireless locomotives which employed heat of combination of a solution for raising steam. Still other attempts of various sorts were made, but the ammonia absorption refrigeration process has, so far, remained the only important commercial application of solution cycles.

This slow acceptance of the several cycles which have been developed for many problems in power generation, heating, refrigeration, air conditioning and thermo compression of process vapors, does not mean, however, that such cycles may not shortly be put to use, for their advantages will be obvious in the light of what follows:

Basic Thermo-Compression Process

All cycles are composed of processes. The basic process peculiar to solution cycles is a thermo compression process, shown in its elemental form as I in Fig. 1. All solution cycles, whether they be simple or complicated, include in one way or another this elemental thermo compression process.

How it works is briefly this: A concentrator or boiler A receives a weak solution of some salt, such as caustic soda dissolved in water, from an absorber C. Here the solution is concentrated by an input of heat of Q_1 at a temperature T_1. After being concentrated by the evolution of vapor, the strong solution is passed through a heat exchanger B and an expansion valve b to the absorber. The vapor G evolved from A at high pressure passes to a second process which may be a prime mover, such as an engine or turbine, or to a refrigeration process, where it performs work in the one case or supplies refrigeration in the other. In either case the low-pressure vapor G' returned to the absorber is absorbed in the strong solution, evolving heat of quantity Q_2, at temperature T_2. T_2 is less than T_1, but greater than the temperature at which G' will condense. As the solution in C absorbs the vapor G', it becomes weaker and

Fig. 1—Basic solution thermo-compression process (I), combined with a power process (II), or a refrigeration process (III)

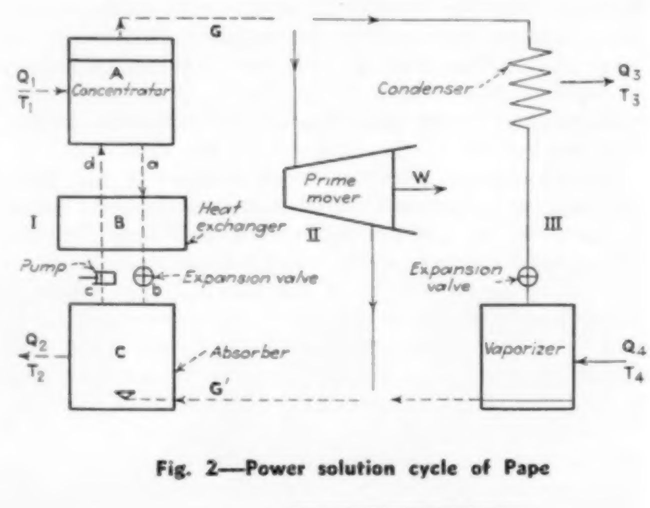
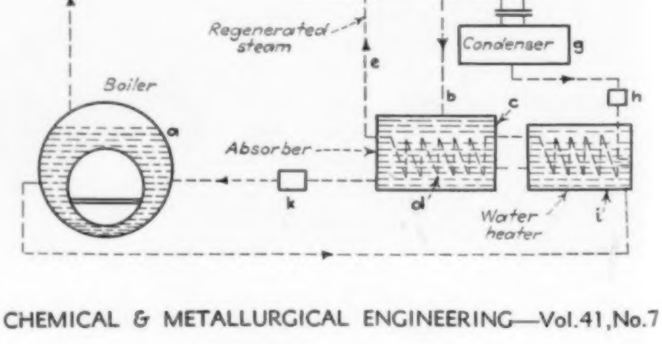


Fig. 2—Power solution cycle of Pape



is pumped through B, where it is preheated, to A where it is reconcentrated for the continuation of the cycle.

[*Editor's Note*—The cycle I-III of Fig. 1 is exactly that of the standard ammonia absorption refrigeration process, with ammonia substituted for NaOH in the above description, and its function interchanged with that of the water. The ammonia is evolved at high pressure from a water solution in a still composed of an "analyzer" and "generator," which takes the place of a concentrator. The vapor is then condensed with the evolution of heat Q_3 at temperature T_3, after which it expands through an orifice into an evaporator where its heat of vaporization Q_4, at a low temperature T_4, comes from the cooling of brine or other refrigeration use. The low-pressure vapor is then absorbed in weak liquor from the bottom of the still, and its heat of solution Q_2 is given up to the water in cooling coils at a temperature T_2. The strong liquor is then pumped back to the still through a heat exchanger. To avoid confusion, it should be noted that the terms strong liquor and weak liquor as applied to ammonia are opposite in sense to the same terms applied to caustic soda and other salts. The still *concentrates* the liquor with respect to water—but weakens it with respect to ammonia. The caustic soda concentrator concentrates the solution with respect to caustic soda, and weakens it with respect to water. For an exact parallel of terms between the two processes, it is necessary to consider the ammonia as the solvent and the water as the solute, which is contrary to usual practice.]

Pape's Power Cycle

A somewhat more complicated power cycle than the one shown in I-II of Fig. 1 is that of Pape, Fig. 2. It illustrates the conventional solution power cycle and is composed of the basic solution thermo compression process (but without heat exchange), combined with a prime mover and a Rankine cycle. A solution boiler (concentrator) *a* absorbs heat and gives off high-pressure steam which is supplied to the prime mover *f*. After partial expansion in *f*, this vapor is bled off and absorbed in concentrated solution in *c*. This concentrated solution reaches *c* by passing from the boiler through a water heater *i*. The heat of solution is used to generate high-pressure steam in the coil *d*, and this steam returns to the prime mover. The weak solution returns to the boiler through pump *k* for reconcentration.

This, then, represents the solution cycle: *afbcka*, for the volatile component, and *aicka* for the solution. The Rankine cycle superimposed on it consists in expanding a part of the steam to the condenser *g*, and passing the condensate through the pump *h*, water heater *i* and coil *d* where it picks up both sensible heat from the strong solution and heat of combination, becoming steam which returns to *f*. This cycle is then *defghd*.

[*Editor's Note*—This cycle bears a superficial resemblance to the mercury-steam binary cycle described in *Chem. & Met.*, p. 204-5, April, 1932, but should not be confused with it. The mercury cycle vaporizes mercury at high temperature, expands the mercury in a turbine, and condenses it in a steam boiler which generates steam for a second turbine. A comparison of the efficiencies of these two cycles would be interesting.]

Theoretical Considerations

The purpose of all solution cycles is to attain higher thermal efficiency through a closer approach than is otherwise possible to the theoretical Carnot efficiency.

It will be recalled that the expression $\frac{T_1 - T_2}{T_1}$ (where T_1 is the absolute temperature at which the heat enters the process and T_2 the absolute temperature at which heat leaves the process) represents the maximum percentage of conversion of heat into work that is possible for any process operating between those temperatures. But this maximum can only be reached by a theoretical process which obeys three conditions:

1. All the heat received by the system must enter at T_1 and none at a lower temperature.

[*Editor's Note*—In a steam boiler, for instance, heat enters at temperatures between the temperature of the feed water and the exit temperature of the saturated—or superheated—steam.]

2. All of the heat leaving the system (as to the condenser) must leave at T_2, none higher.

3. Every step in the cycle must be truly reversible. It is this condition, ruling out friction, throttling, etc., which is most difficult to approach in practice.

The reason for using solutions instead of single fluids now becomes apparent, for all of the heat enters at the temperature of superheated steam (the vapor from a solution is superheated in so far as the boiling point of the solution exceeds that of the pure solvent), while in a single-fluid boiler, most of the heat enters at the saturation temperature and only a little at the superheat temperature. Furthermore, solutions can be used having a high boiling temperature at comparatively low pressure, thus giving the advantages of high pressure cycles, without the troubles of high pressure. Solution cycles then make possible the practical attainment of the first two conditions for approaching the Carnot efficiency. The third condition is also approached more closely by solution cycles because they are able to employ means not possible with one-component cycles.

A rough approximation of the coefficient of performance of a refrigeration cycle is given by the expression:

$$\frac{\text{Heat absorbed for refrigeration}}{\text{Heat supplied for operation}} = \frac{T_w}{T_s}$$

where T_s equals absolute boiling point of the solution and T_w equals absolute boiling point of the pure volatile component at the same pressure (see original paper for derivation).

Koenemann's Ammoniacate Cycle

In recent years there has been considerable interest in solution cycles, particularly in Germany. In 1930 Koenemann described a solution power cycle which employed ammonia as the solvent, and zinc chloride as the solute. It is essentially the cycle shown by Fig. 2, except that the turbine stage *ab* is replaced by a turbine which operates on ammonia vapor. The cycle was commented on favorably by the technical press in this country and abroad.

The ammonia vapor in this proposed operation is

evolved by the decomposition of the ammoniacate and becomes once more recombined in its original form after having performed work. The cycle is represented by:

$$ZnCl_2 \cdot 2NH_3 = ZnCl_2 \cdot NH_3 + NH_3$$

The initial pressure is 100 lb. per sq.in. abs. in the ammonia vapor stage, and 300 lb. per sq.in. abs. in the steam stage. Heat enters the cycle at 896 deg. F., which is comparable with the upper temperature used in the mercury vapor power cycle.

An ammonia-water absorption refrigeration cycle recently proposed by Altenkirch, and in operation in Germany, differs from the standard cycle (see above) in employing an additional absorber and evaporator between those used in the standard process. It makes possible the employment of a still higher temperature of supply of the operating heat, hence a greater spread between the entering and rejection temperatures and a higher efficiency. Its coefficient of performance over the ordinary range has been stated to be more than twice that of the standard ammonia absorption cycle.

Comparison of Power Cycles

The simple power cycle illustrated in Fig. 1, I-II, can be modified as in Fig. 3 so that the heat of solution of the low-pressure vapor from prime mover 1 is used to boil water and make steam for prime mover 2. This cycle is quite similar, therefore, to the mercury-water cycle (see above). It is interesting to compare its results, based on calculations from the somewhat limited data available, with a simple Rankine power cycle consisting of boiler, superheater, prime mover, condenser and feed water pump. This comparison appears in Table I, and shows an increased efficiency of 37 per cent for the solution cycle. In both cycles the efficiencies would be considerably higher if the exhaust pressures were lower. Table II gives a similar summary of operating conditions for the solution thermo-compression process of Fig. 1 applied to air-conditioning operations. Since the solution thermo-compression

Table I—Comparison of Simple Rankine and Solution Power Cycles

	Rankine Steam Cycle	Solution Steam Cycle Fig. 3
Maximum cycle temperature	487 deg. F.	487 deg. F.
Minimum cycle temperature	212 deg. F.	212 deg. F.
Temp. of steam to prime mover	487 deg. F.	487 deg. F. to 1 and to 2
Pressure of steam to prime mover	125 lb. abs.	125 lb. to 1; 77.7 lb. to 2
Pressure of exhaust steam	14.7 lb.	24 lb. from 1 14.7 lb. from 2
Quality of exhaust steam	94 per cent	97 per cent from 1 98 per cent from 2
Heat to cycle (boiler and superheater) per lb. 125-lb. steam	1,089 B.t.u	1,403 B.t.u.
Work obtained from prime movers (85 per cent eff.)	148 B.t.u.	261 B.t.u.
Efficiency of conversion	13.6 per cent	18.6 per cent

Table II—Operating Conditions for Solution Refrigeration Cycle

(Cycle of Fig. 1; 5 tons = 60,000 B.t.u. per hr. capacity)

	Temperature, Deg. F.	Pressure, Lb. per Sq.In.	Concentration, Weight Per Cent NaOH
Concentrator A	161	0.6980	50
Concentrated solution leaving heat exchanger B	105	0.6980	50
Condenser	90	0.6980	0
Vaporizer	40	0.1217	0
Absorber C	90	0.1217	45 (b.p. 97 deg. F.)

Heat required Q_1 = 81,680 B.t.u. per hr.
Heat absorbed Q_4 = 60,000 B.t.u. per hr.
Coefficient of performance = 0.735.

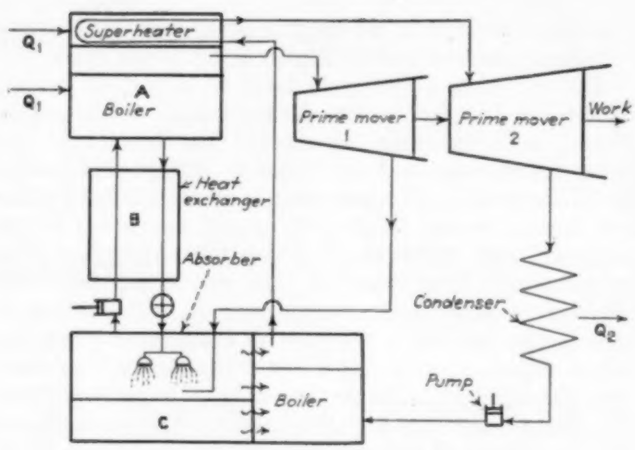


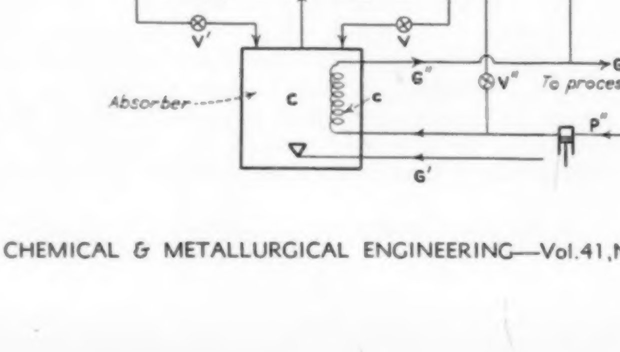
Fig. 3—Simple solution power cycle

unit requires heat at only 161 deg. F., it may be operated with steam at atmospheric pressure, or less, as a source of heat (about 7.7 lb. per sq.in. abs. is the minimum, allowing for 20 deg. F. temperature drop). Operated in such a manner, about 85 lb. of steam at 7.7 lb. pressure is required per hour for a 5-ton unit. On the other hand, modern efficient steam jets, using steam at 70 lb. per sq.in. abs. pressure and working over the same pressure limits (corresponding to 40 and 90 deg. F.) require about 750 lb. of steam per hour for 20 tons of refrigeration, giving a coefficient of performance of about 0.285. Allowing substantially the same efficiency for a 5-ton unit, the steam jet requires about 190 lb. of steam at 70 lb. pressure, as compared with 83 lb. of steam at one-half atmospheric pressure for the simple, basic solution thermo compressor. Operation of the jet requires condensing capacity for about 250 lb. of steam per hour as compared with 60 lb. per hour for the simple basic solution cycle.

Multiple Effect Cycles

Recent improvements of these solution cycles (U. S. patents applied for by Mr. Sellew) make it possible to increase both efficiency and operating range of these

Fig. 4—Solution thermo compressor incorporating double-effect concentration with single-effect absorption



solution cycles. Fig. 4 shows a fundamental modification which, by absorbing heat at a higher temperature than that needed in the process, makes it possible to attain higher efficiency with greater range and more flexibility. This cycle uses a multiple-effect concentrator, in which A' is maintained at a pressure elevated enough to furnish vapor having a condensation temperature sufficiently high to serve as a source of heat for A. (Note the distinction between the temperature of the superheated vapor evolved by A' and its condensation temperature.—Ed.) This vapor in condensing in a and again in c generates an increased quantity of process vapor $(G + G'')$ without the expenditure of much more heat than was required by A in the single-stage process. The reason for this increase is that heat is absorbed at a higher temperature.

In a cycle such as that of Fig. 4, using 60 per cent

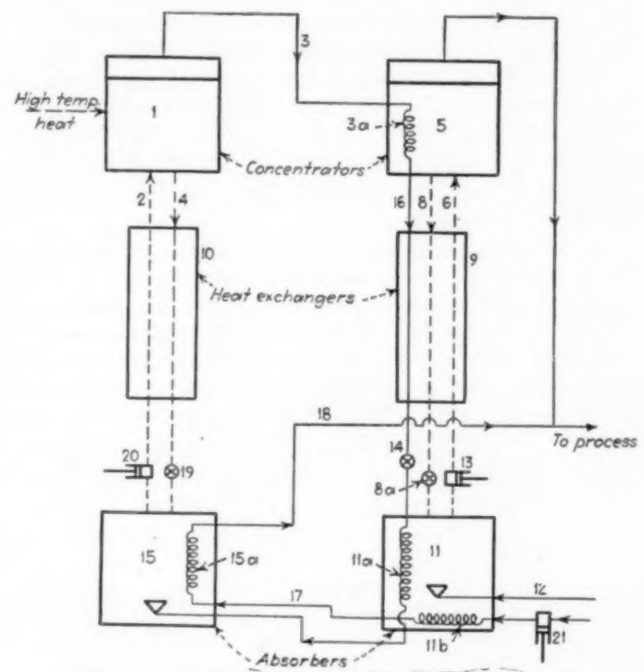


Fig. 5—Solution thermo compressor incorporating double-effect concentration and absorption

caustic soda in the concentrators and 55 per cent solution in the absorber, 800 B.t.u. at 492 deg. F. supplied to the concentrator A', which operates at 131 lb. per sq.in., will compress 1 lb. of steam from 4 lb. pressure to 15.9 lb. per sq.in. A steam jet supplied with steam at 131 lb. pressure and 492 deg. F., generated in a boiler from feed water at 70 deg. F., will require about 3,700 B.t.u. on the basis of 3 lb. of activating steam per pound of low-pressure steam, more than four and a half times as much heat as that for the solution thermo compressor. Actually, it is probable that this is more than fair to the steam jet.

Another multiple-effect cycle, similar to Fig. 4 except that the absorber also has two effects, can be used to increase the compression ratio over that in the example above. (See Fig. 5.) Calculation for this cycle shows an energy consumption of 1,760 B.t.u. to compress 1 lb. of steam from 1 to 18.9 lb. per sq.in. pressure. The performance is summarized in Table III. If an attempt were made to use a steam jet for this compres-

Table III—Representative Operating Conditions for Fig. 5

	Temperature, Deg. F.	Pressure, Lb. per Sq.In.	Concentration, Weight Per Cent NaOH	Relative Weights
Concentrator 1	500	151	60	....
Solution 19	259	151	60	....
Concentrator 5	339	18.9	60	....
Condensate from 3a	359	151	0	....
Absorber 11	179	1	55 (b.p. 183 deg. F.)	....
Condensate 14	194	151	0	....
Solution 8a	194	18.9	60	....
Steam 11a	160	4.74	0	....
Absorber 15	244	4.74	55 (b.p. 248 deg. F.)	....
Steam 15a	225	18.9	0	....
Steam 3	500	151	0	1.28
Steam 12	102	1	0	1
Water 21	70	18.9	0	1.48
Steam 7	339	18.9	0	1
Steam 18	225	18.9	0	1.48

Heat Requirements

To deliver 1 lb. of steam at 18.9 lb. per sq.in.	710 B.t.u.
To compress 1 lb. of steam from 1 lb. to 18.9 lb. per sq.in.	1,760 B.t.u

sion ratio, two stages would be required and the consumption of steam at 150 lb. per sq.in. would be about 20 lb., requiring 25,000 B.t.u. as compared with 1,760 B.t.u. in the double-effect solution cycle. Except over small compression ratios recompression of process vapors with jets has not proved economical.

With the use of multiple-effect concentration and absorption as suggested in this last example, it is clear that the solution thermo compressor can easily and economically attain high compression ratios which are entirely impracticable by other methods. For example, such a compression ratio as 19 is entirely out of the question with steam jets unless two stages are used, with enormous steam consumption. Ten stages in a centrifugal compressor will compress low-pressure water vapor to a compression ratio of 6, but no centrifugal compressor has yet been developed to operate over a ratio of 19.

Energy Storage and Transportation

One further feature of solution cycles has most interesting possibilities, namely, the efficient storage or transportation of large quantities of available energy in the form of concentrated solution and pure solvent. The chemical energy stored in such a system can be made instantly available by means of a solution cycle, and yet can be stored indefinitely, or transported through uninsulated lines without loss of energy. Using a suitable cycle and heat exchangers, dilute solution supplied at atmospheric temperature to a concentration plant may be converted into concentrated solution, and solvent, which is also made available at atmospheric temperature for immediate use or for storage without loss. The two can be re-combined as desired to supply heat. Hence, the concentrating plant may operate at constant load with maximum efficiency throughout the 24 hours, with the fluctuation in load met by the storage of solution and solvent.

In conclusion, the intensive development of one-component cycles has now reached such a stage of perfection that consideration should be given to the broader possibilities of the solution cycle. Although the immediate costs in obsolescence of present equipment may delay the commercial application of solution cycles to central power stations, new and important industries such as air conditioning and cooling of buildings offer a wide field for commercial development of solution cycles. Such cycles should, furthermore, have many applications in heating and cooling in process plants.

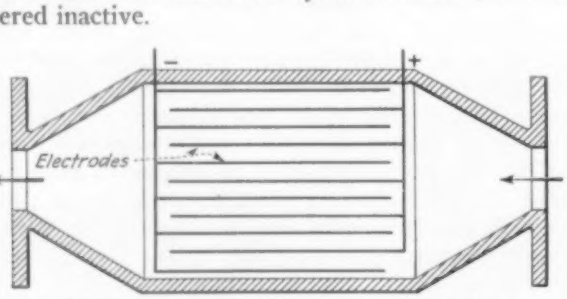
Silver Proves Effective in Water Sterilization

MUCH INTEREST is being displayed in an electrochemical process for the sterilization of water by treatment with silver—the Katadyn process, introduced in this country from Germany, where it has been in use for about five years. The method, developed by Dr. G. A. Krause, of Munich, is based on oligodynamy, the property of minute traces of certain metals, particularly silver, to sterilize water. A purification unit has recently been installed by the Congressional Country Club, Washington, in the new 150,000 gal. swimming pool.

Water treated by the Katadyn process takes on bactericidal properties which persist as long as silver remains in solution. The action of the silver is not immediate, but requires from 30 min. to several hours, depending on the quality of the water and the bacteria involved. The quantity of silver is so small that it is without any harmful effect to the human system, and the treatment does not impart any objectionable smell, taste, or color to the water.

Two methods may be applied for bringing the silver into solution, the contact method and the electrolytic method. In the former, which is used where relatively small quantities of water are to be treated, the silver brought into contact with the water is deposited on carriers of porcelain or quartz, in a comparatively large quantity constituting a supply which assures several years' operation without attention. This type is suitable for domestic purposes and for small portable units.

For large installations the greater quantity of contact material required would, however, involve too great expense. The process of coating the contact mass with silver is, incidentally, greater than the cost of the silver itself, for which reason it is necessary to apply a heavy coating that will last a long time. This would result in too great a silver tie-up on a large scale. Another disadvantage is that the contact method is limited to water free from suspended matter, as a certain part of the dissolved silver is adsorbed by this material and thus rendered inactive.



Activator equipped with silver electrodes

Where large quantities of water are treated the electrolytic method is therefore used. The essential piece of equipment used in this procedure is the activator shown in the accompanying sketch, in which the water is charged with silver ions. It consists of an iron tank, lined with a special insulating material, in which are placed electrodes of silver, of a definite weight designed to give the desired length of life. Polarization is prevented by automatically reversing the current at definite intervals. The voltage applied should not exceed 1.6 volts, to prevent electrolysis of the water, and the current varies from 0.02 to 10 amp., according to the size of the plant. Energy consumption is so small that its cost may be disregarded for all practical purposes; in the most unfavorable cases it is less than 0.001 kw.-hr. per ton of water treated. Cost of silver, according to the degree of activation desired and the quality of the water treated is about 0.1c. per ton of water for drinking purposes and may run as high as 1-1½c. for highly bactericidal rinsing water to be used in food and beverage plants.

The characteristics of the water is important in the design of the activator. Any certain water has a definite conductivity depending on the temperature and the salts and acids contained; the pH value also affects the sterilizing action, neutral and alkaline reactions accelerate the action, while acid reaction retards the effect. Suspended matter may cause a loss in silver due to adsorption and a certain factor of safety should be applied to the degree of activation where such a condition exists.

The activator occupies little space compared with the large surface required in the contact method; the electrodes are easy to remove and may therefore be cleaned and renewed with great ease. Only limited supervision is required, and the operation may be made partly or completely automatic.

In addition to its use for sterilization of water used for drinking purposes and in swimming pools and ice plants, the electrolytic Katadyn process has found many important industrial applications. It may be used for the preparation of highly bactericidal water for washing, rinsing, and disinfecting equipment in beverage and food plants, in the vinegar industry, and in the manufacture of pharmaceuticals. The degree of activation required in the various applications, expressed in milligrams of silver per metric ton of water, is approximately:

	Mg. Silver per Ton of Water
For drinking purposes	25-100
For swimming pools	150-200
For ice manufacture	400
For mineral water	25-100
For washing and rinsing in industrial plants	25-600

Among successful installations in Germany at the present time may be mentioned the following: (1) A purification plant for drinking water near Heidelberg, with an hourly capacity of 5 tons, using an activation of 30 to 50 mg. per cu.m. Current is supplied from a storage battery and the operation is semi-automatic. (2) A swimming pool at the stadium at Frankfort, of 1,600 cu.m. capacity, and with a flow of 60 cu.m. per hour, employing three parallel activators, each with a capacity of 1.4 volt and 2 amp. Silver consumption is 12,000 mg. per hour, permitting an activation of 200 mg. per ton. (3) An ice plant in Dresden with an hourly output of 10-20 cu.m. of ice, with a current of 2.5-3 amp. at 1-1.5 volts, producing a degree of activation of 400 mg. silver per ton. (4) A brewery in Munich treats 3.5-4 tons of water per hour, producing highly bactericidal rinsing water with 600 mg. of silver per ton. It operates by storage battery, at 1-1.5 volts and 0.9-1.2 amp.

An electrolytic plant with a maximum hourly capacity of 50 cu.m., activated to 100 mg. silver per ton, was installed on the new German cruiser Königsberg. This installation has given such good results that several additional units have been ordered for the German Navy.

OTHERS' VIEWS

Refrigeration S-O-S's

To the Editor of Chem. & Met.:

Sir—The article "Refrigeration A-B-C's for Chemical Engineers" in your April issue contains certain statements which are open to question.

The section on the Joule-Thomson effect is particularly misleading. It is stated that the temperature decreases to be expected when expanding saturated hydrocarbon vapors will be less than those given for air because the ratio of specific heats for hydrocarbons is less than that for air. This reasoning is incorrect. Helium, with a high ratio of specific heats, has a negative temperature drop on free expansion, except at very low temperatures, while carbon dioxide shows a much greater temperature drop than air from the same initial conditions. Qualitatively, the more imperfect the gas, the greater will be the Joule-Thomson effect.

The belief that free expansion results in an appreciable reduction in temperature may or may not be general, but it is not necessarily erroneous. It all depends on the gas, the temperature and pressure conditions, and what is considered to be "appreciable." I know of no data on hydrocarbons in a form readily used, but the cooling effect with methane is about 50 per cent greater than the value given in this article for propane. The higher hydrocarbons give more cooling effect. A normal value for "dry" natural gas is 3.2 B.t.u. per lb. per 100 lb. per sq.in. under pipe line conditions, while 6.0 B.t.u. per lb. per 100 lb. per sq.in. is a reasonable figure for "dry" gas from a cracking still high pressure condenser.

Although propane tables are not yet available, we do have tables for two other refrigerants mentioned in the article, ammonia and water. When ammonia expands with constant heat content from saturation at 187 lb. per sq.in. abs. to 20 lb. per sq.in. abs. it cools from 92 deg. F. to 31 deg. F., which is quite appreciable. Or, if the process is isothermal rather than adiabatic, it absorbs 32.1 B.t.u. per lb. Similarly, water vapor on expanding with constant heat content from saturation at 187 lb. per sq.in. abs. to 20 lb. per sq.in. abs. cools 64 deg. F., or expands isothermally from the same initial condition to the same final pressure with the absorption of 30.4 B.t.u. per lb. Sulphur dioxide furnishes a more striking example. At 140 deg. F., the saturation pressure is 159 lb. per sq.in. abs. Expanding with constant heat content to 20 lb. per sq.in. abs. causes the temperature to fall to 26.4 deg. F., and causes condensation of about 3 per cent as well. Carbon dioxide refrigerating plants have operated with condenser water of temperature higher than the critical temperature of the medium. Can we really "eliminate the free expansion method from further serious consideration as a possible refrigerating means"?

When there is available gas at high pressure which is to be used at lower pressure, and when it is desired to obtain some refrigerating effect from the expansion, it may become necessary to choose between free expansion and engine expansion, and a comparison of the processes is legitimate. Similarly, in case it is necessary to consider properties of the refrigerant other than the thermodynamic properties — health or fire hazards, for example — we may have to compare an air system working on the engine expansion cycle with a carbon dioxide system working on the Joule-Thomson cycle. But the comparison which is made in this article is meaningless. The uninformed reader might conclude that the only thing to consider in choosing a refrigerating cycle is the unit refrigerating effect, which is far from true.

BENJAMIN MILLER
Henry L. Doherty & Co.
New York, N. Y.

EDITOR'S NOTE: This letter as printed is a condensation of a more extended criticism which has had the author's attention and approval.

Synthetic File for Flow Sheets

To the Editor of Chem. & Met.:

Sir—May I suggest an improvement on Mr. Klipster's chemical engineering file described and illustrated in your June issue? You will recall that after he had assembled his collection of *Chem. & Met.* flow sheets and data compilations, he betook himself to the local 10-cent store for his filing cabinet. Wouldn't it have been more appropriate to use one of General Electric's new Textolite card-index file cabinets—itself a handsome product of chemical engineering, since it is made of synthetic resin? Of course it would cost him a little more money, but think how much better it would protect his valuable records from the acids and alkalis, fumes and vapors.

A Real Chemical Engineering File

N. S. STODDARD
G. E. Plastics Department,
Lynn, Mass.

25 Years of Technical Publishing

ON July 1, 1909, eight years before the merger of the McGraw and the Hill publishing companies, the book department of the Hill Publishing Co. joined the book department of the McGraw Publishing Co., in establishing a new publishing house for scientific and engineering books. The twenty-fifth anniversary of this occasion was celebrated at a luncheon held in the new McGraw-Hill Building in New York on June 28, 1934. Highlights of this publishing period reviewed by Martin M. Foss, president, included a tribute to the late Dean H. P. Talbot of the Massachusetts Institute of Technology, who founded and edited the International Chemical Series which has grown to 47 volumes. Since his death this series has been continued under the guidance of Dr. James F. Norris of M. I. T. The Chemical Engineering Series established in 1928, now includes nine volumes with two in press. The publication of the International Critical Tables, in cooperation with the National Research Council, was cited as one of the most significant contributions to technical publishing in America.

BOOKSHELF

High-Pressure Technology

The Design and Construction of High Pressure Chemical Plant. By *Harold Tongue*. Published by Chapman and Hall, London. 420 pages. Price, 30 shillings.

Reviewed by *Norman W. Krase*

THIS BOOK is probably the first comprehensive treatment of the design and engineering principles involved in the new technology relating to high pressure developments. It is concrete evidence that the interest and number of workers in this field has reached such proportions as to justify the creation of a separate literature dealing exclusively with the problems peculiar to this field. The best thing that the book does is to get between two covers material which previously had been widely scattered. While the practice is largely English and European, one finds frequent references to American development.

The principal subjects covered are compressors, pressure vessel design both at ordinary and high temperatures, auxilary equipment such as gages, fittings, and valves, suitable materials of construction, autoclave design and a chapter on the manufacture of large pressure vessels. Interspersed among these chapters are frequent references to process patents and developments relating to the synthesis of particular compounds. The book is admirably illustrated with excellent drawings and photographs. One can easily overlook the interchanging of legends on one or two drawings such as figures 31 and 32 in considering the general excellence of this work. There is no doubt but that all laboratories and research workers in this new branch will find the volume not only a valuable reference work but also a stimulating piece of reading.

Orientation and Motivation

Building an Engineering Career. By *Clement C. Williams*. Published by McGraw-Hill Book Co., New York. 247 pages. Price, $2.

FOR THE PAST SIX YEARS, Dean Williams of the College of Engineering at State University of Iowa has conducted a course to aid the student in his choice of a vocation by affording him a background of achievements in the different branches of engineering. The course also aims at motivation as well as orientation for the students' interest must be stimulated and his viewpoint and mode of thinking developed during this formulative period. Growing out of this course of instruction, Dean Williams has developed a unique text book in three parts, viz.: I. Education for Engineering. II. Historical Background of Engineering, and III. Achievements in Engineering. A well illustrated chapter on chemical engineering achievements, prepared in cooperation with Prof. H. L. Olin, reflects many of the most significant developments in this youngest of the major divisions of engineering.

A Successful Success Book

If You Want to Get Ahead. By *Ray W. Sherman*. Published by Little, Brown & Co. 186 pages. Price, $1.50.

Reviewed by *Chaplin Tyler*

AS A FORMER EDITOR and as a frequent reviewer of books for business papers I frankly adopt a rather critical, "hard-boiled" attitude toward them. There are too many books anyway (I've written one myself!) and surely there is no dearth of supply of "success" books. But I'll admit freely that Ray Sherman has produced a successful "success" book.

Sherman has provided in condensed form and in crisp readable style a valuable check list of concrete points for the business man who would really improve himself and earn more money. The principal points (in the reviewer's words) are: Most men are better than they realize, that is, only simple adjustments in habits or working methods are necessary to bring out latent power; Most men fail diligently to follow up opportunities; Most men have poor office technique, that is, they don't plan their work even a day ahead and then "work the plan"; A common cause of ineffectiveness is doing a lot of relatively non-essential work at the expense of really important work; Personal appearance is far more indicative of the man than most of us realize; Failure or disinclination to seek and utilize the advice of experienced subordinates, associates or superiors is the cause of much ineffectiveness; Ego, or delusions of being a "big shot" is a terribly destructive factor; Personal mannerisms are more important than may be realized; Listening is an art most men never learn, especially salesmen; Treatment of subordinates is an indication of ability and breeding or lack of it; One must learn, especially in executive work, to tackle unpleasant tasks with promptness and energy; Finally, the man *must* be his own most severe disciplinarian if he would attain the goal which he sets.

The reviewer suggests that 1934 is a good time for *young* men especially, to take steps to improve themselves, because the depression has done much to "debunk" the supposed super-abilities possessed by older so-called "big-shot" bankers, industrialists, salesmen, politicians, business "prophets," editors and college professors. After all, we now realize that a tide of affairs carried these men along and when the tide turned they were either submerged ignominiously or swept along helplessly like the rest of us ordinary folks. Therefore, those men who have no such past to live down can easily build up themselves. Sherman's book is a useful primer for such endeavors.

Gas Handbook

Gas Engineers' Handbook. Prepared by Pacific Coast Gas Association and reviewed by special committee of American Gas Association. Published by McGraw-Hill Book Co., New York. 1934. 1,017 pages. Price, $7.50.

Reviewed by *R. S. McBride*

"IT HAS BEEN the purpose, in the compilation of the Gas Engineers' Handbook, to bring together the basic information most frequently needed in gas engineering. In doing this, numerous formulas, tables, and graphs have been included which will assist in the quick solution of many of the common problems of gas manufacture, transmission, distribution, and utilization, supplemented where necessary with an explanation of their derivation and use." The Committees engaged in preparation and review of this volume so state their purposes. And they have admirably accomplished the objective which they thus set for themselves.

Gas engineers have had urgent need for this sort of a handbook. The sponsorship and recommendation of this volume by American Gas Association bespeaks the importance attached to it by the outstanding men of the industry. A less satisfactory volume would never have been indorsed by the directors of A.G.A. And it is clear that the directors made no mistake in their indorsement. The book may not be perfect, for no book is; but it is so far superior to anything else available for gas engineers and for those who occasionally have gas-engineering problems to solve as to deserve unanimous support of all interests.

All chemical engineers should consider this book as a specialized com-

panion volume to accompany "Chemical Engineers' Handbook," edited by Perry. Because of the larger space available for treatment of many specialized themes, this newer work will greatly facilitate handling of chemical questions relating to gas and other fuels. This usefulness will not be limited to the fuel gases, however, since many parts of the "Gas Engineers' Handbook" are just as applicable to questions of flow of fluids, measurement, regulation, compression, transmission, and handling for gas of all types, not alone city gas for which the section was primarily intended. Hardly a works of the chemical process industries does not have industrial gas problems. Hardly a works library, therefore, can escape serious consideration of this book as a very useful addition to the tools of engineering literature.

Popularized Chemistry

OUT OF THE TEST TUBE. By *Harry N. Holmes.* Published by Ray Long and Richard R. Smith, Inc., New York. 373 pages. Price, $3.

FEW WRITERS possess the peculiar competence of an Ellwood Hendrick or an E. E. Slosson when it comes to popularizing our science. Hence there have been many mediocre efforts in this direction, usually undertaken by professional literary folk, who do not have a firm grounding in chemistry on which to build their airy super-structures. That criticism, of course, cannot be applied to Prof. Harry Nicholls Holmes of Oberlin College who has been at the forefront of progress in both fundamental and applied chemical research. He presents a soundly scientific story in a way calculated to interest and convince the layman who seeks an explanation of chemistry's far-reaching influence on modern life. If a certain fineness of phrase or vividness of color which this reviewer unconsciously associates with the old masters, is occasionally lacking, it is no reflection on the author or on the publisher, whose first excursion outside of the field of fiction may well be encouraged.

ORGANIC SYNTHESES. Vol. XIV. An annual publication of satisfactory methods for the preparation of organic chemicals. *W. W. Hartman,* editor. John Wiley & Sons, Inc., New York. 100 pages. Price, $1.75.

TWENTY-SIX new syntheses are included in this volume. Later references to preparations in the preceding volumes and additions and corrections to these volumes are compiled in an appendix. The index includes those of Vol. X to XIII, incl.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Manganese. A survey of the industry in five parts, published in Bureau of Mines Information Circulars (mimeographed) dealing with occurrence, milling, and metallurgy. Part I is I. C. 6768, comprising sections on physical properties and preparation of metallic manganese, manganese in nonferrous alloys, compounds of manganese, and occurrence and ore-dressing possibilities of ores of manganese in the U. S. Part II, I.C. 6769, thermodynamic properties of manganese and its metallurgically important compounds; review of literature and original calculations for metallic manganese, oxides of manganese, manganese sulphide, manganese carbonate, manganese sulphate, manganese chloride, manganese carbide, and manganese nitride. Part III, I.C. 6770, general metallurgy of manganese, hydrometallurgy of manganese, and pyrometallurgical treatment of manganese ores. Part IV, I.C. 6771, ferrous alloys of manganese and their use in the steel industry; discusses manganese in liquid-steel metallurgy, manganese steels (pearlitic, martensitic, and austenitic), and manganese in cast iron. Part V, I.C. 6772, bibliography and indexes; contains all bibliographic references cited throughout first four parts of report and indexes of report by authors and subjects.

Meerschaum, by Alice V. Petar. Bureau of Mines Information Circular 6780; mimeographed. Describes properties, occurrence, uses, mining and preparation, world production, domestic production and deposits, imports, prices, tariff, industry in foreign countries, and bibliography.

Calcium Chloride, by Paul M. Tyler. Bureau of Mines Information Circular 6781; mimeographed. Shows commercial importance and uses of calcium chloride, a by-product in the Solvay process for manufacture of sodium carbonate, as a joint product for natural salt brines.

Greensand, by Paul M. Tyler. Bureau of Mines Information Circular 6782; mimeographed. Discusses deposits in the U. S. as a potential source of potash and water-softening agency.

Studies in the Metallurgy of Copper, by R. S. Dean, and others. Bureau of Mines Report of Investigations 3228; mimeographed.

Studies in Direct Production of Iron and Steel From Ore, by R. S. Dean and others. Bureau of Mines Report of Investigations 3229; mimeographed.

Table Cleaning of Fine Coal From the Thompson and Woodstock Beds of the Cahaba Field, Alabama, by A. C. Richardson and others. Bureau of Mines Report of Investigations 3234; mimeographed.

Removal of Sodium Chloride From Crude Polyhalite Washing, by J. M. Davison and F. Fraas. Bureau of Mines Report of Investigations 3237; mimeographed. Part VIII of a study of the properties of Texas-New Mexico polyhalite relating to the extraction of potash.

Summary of Experimental Data on Laboratory Oxidation of Crude Oils, With Particular Reference to Air Repressuring, by Sam S. Taylor and H. M. Smith. Bureau of Mines Report of Investigations 3238; mimeographed.

Solubility of Carbon in Iron-Manganese-Silicon Alloys, by C. H. Herty, Jr., and M. B. Royer. Bureau of Mines Report of Investigations 3230; mimeographed.

The Iron Blast Furnace, by T. L. Joseph. Bureau of Mines Information Circular 6779; mimeographed.

Mineral Production Statistics—printed pamphlets giving detailed statistics to supplement Minerals Yearbook 1932-33 on: Gold and Silver, by J. P. Dunlop, 5 cents; Coal, by W. H. Young and others, 5 cents.

High-Temperature Specific-Heat Equations for Inorganic Substances, by K. K. Kelley. Bureau of Mines Bulletin 371; 10 cents. Part II of contributions to the data on theoretical metallurgy.

Accounting System and Office-Management Procedure for Medium-Size Metal Mines, by Albert E. Keller. Bureau of Mines Bulletin 372; 10 cents.

Mineral Production Statistics for 1933—preliminary mimeographed statements from Bureau of Mines on: Asphalt; road oil sales; special cements; carbon black sales.

Comparison of Tariff Acts. U. S. Tariff Commission unnumbered pamphlet; 20 cents. Contrasts Tariff Acts of 1930 and 1922.

Chemicals Statistics. U. S. Tariff Commission Release of June 25, 1934; mimeographed. Production and sales of dyes and other synthetic organic chemicals in 1933.

Practices of the Steel Industry Under the Code. Senate Document No. 159, 73rd Congress, 2nd Session. Report of the Federal Trade Commission to the Senate.

Cautions Regarding Gas-Appliance Attachments, by J. H. Eiseman. Bureau of Standards Circular 404; 5 cents.

Anti-Dimming Preparations for Glass Surfaces. Bureau of Standards Letter Circular 414; mimeographed.

Radium Protection for Amounts up to 300 Milligrams. Bureau of Standards Handbook 18; 5 cents.

Summary Report of Bureau of Standards Research on Preservation of Records, by A. E. Kimberly and B. W. Scribner. Bureau of Standards Miscellaneous Publication No. 144; 5 cents.

World Economic Review, 1933. Bureau of Foreign and Domestic Commerce unnumbered document; 20 cents.

Foreign Commerce Yearbook, 1933. Bureau of Foreign and Domestic Commerce, unnumbered volume; $1.00 (cloth bound). A statistical reference volume.

Liquid Sulphur Dioxide as a Fumigant for Ships, by C. L. Williams. U. S. Public Health Service Reprint No. 1615; 5 cents.

State and Insular Health Authorities, 1933. Public Health Service Reprint No. 1604; 5 cents. Directory, with data as to appropriations and publications.

Acquatic Shell Industries, by F. F. Johnson. Bureau of Fisheries Circular No. 15; 5 cents. Includes lime discussion.

Petroleum Products Specifications. Federal Specification VV-L-791; 15 cents. Specifications for lubricants and liquid fuels; general specifications (methods for sampling and testing).

Changes in Composition of American Fertilizers, 1880-1932, by A. L. Mehring and A. J. Peterson. Department of Agriculture Circular 315; 5 cents.

Orchard Insects of the Pacific Northwest and Their Control, by E. J. Newcomer. Department of Agriculture Circular 270; 10 cents (Revised March, 1934).

The Nitrogen Nutrition of Tobacco, by W. W. Garner and others. Department of Agriculture Technical Bulletin 414; 10 cents.

Growth in Selectively Cut Ponderosa Pine Forests of the Pacific Northwest, by Walter H. Meyer. Department of Agriculture Technical Bulletin No. 407; 10 cents.

The Edible Fat Problem in Germany, by H. E. Reed. Bureau of Agricultural Economics, F.S.-61; mimeographed.

List of Available Publications of the U. S. Department of Agriculture Jan. 2, 1934. Department of Agriculture Miscellaneous Publication 60.

Workers in Subjects Pertaining to Agriculture in State Agricultural Colleges and Experiment Stations, 1933-34. Department of Agriculture Miscellaneous Publication 180; 10 cents.

Production Statistics From 1933 Census of Manufactures in preliminary mimeographed form for: Tin cans and other tinware; electroplating; malt; asphalted-felt-base floor covering and linoleum; abrasive wheels, stones, paper, and cloth, and related products.

PLANT NOTEBOOK

SAGGING TANK FOUNDATION SUCCESSFULLY REPAIRED BY GROUTING

By Ezra K. Nicholson
Cleveland, Ohio

DURING an expansion of storage capacity at the Du Pont company's Belle Works, it was necessary to erect a 500,000-gal. storage tank (approximately 48 ft. in diameter by 35 ft. high) on a site, one-half of which was a year-old fill about 6 ft. deep.

The side walls were poured first and the fill thoroughly puddled before the pad for the tank bottom was poured. In Fig. 1 is shown a typical section through the foundation. However, with the tank erected and about two-thirds filled with water for a final test before being placed in service, peculiar deformations were noticed in the lowest row of side plates. Shortly after this a horizontal crack in the side wall of the concrete foundation, just below the bottom of the pad, was observed. This crack extended almost completely around the foundation and varied in width, being the widest in the vicinity of the greatest fill. A thorough inspection revealed that the roof of the tank had also sagged slightly and that there were several very fine, vertical cracks in the side wall of the foundation.

Center Sank 5 In.

When the water was drained out of the tank and the lower manhole cover removed, the center support for the roof could be seen swinging clear of the tank bottom by several inches. A level was set up outside the manhole and the center of the tank bottom was found to have sunk about 5 in. Fig. 2 indicates the condition of the foundation and center support at this time.

After a careful inspection of the foundation, it was decided to drill several holes through the side walls, slightly below the bottom of the pad, to try to restore the pad to its original elevation by forcing a grout mixture under it with air pressure.

Two tanks about 4 ft. in diameter by 6 ft. high, with large nozzles, a portable air compressor and a concrete mixer were placed near the foundation. For injecting the grout under the sunken pad, two 2-in. pipes, about 20 ft. long were closed, pointed and slotted at one end. These injection pipes were connected to the charging tanks with 2-in. pipe, the length and location of which were altered whenever it was necessary to change the location of the injection pipes. In Fig. 3 the general arrangement of the grouting equipment is shown.

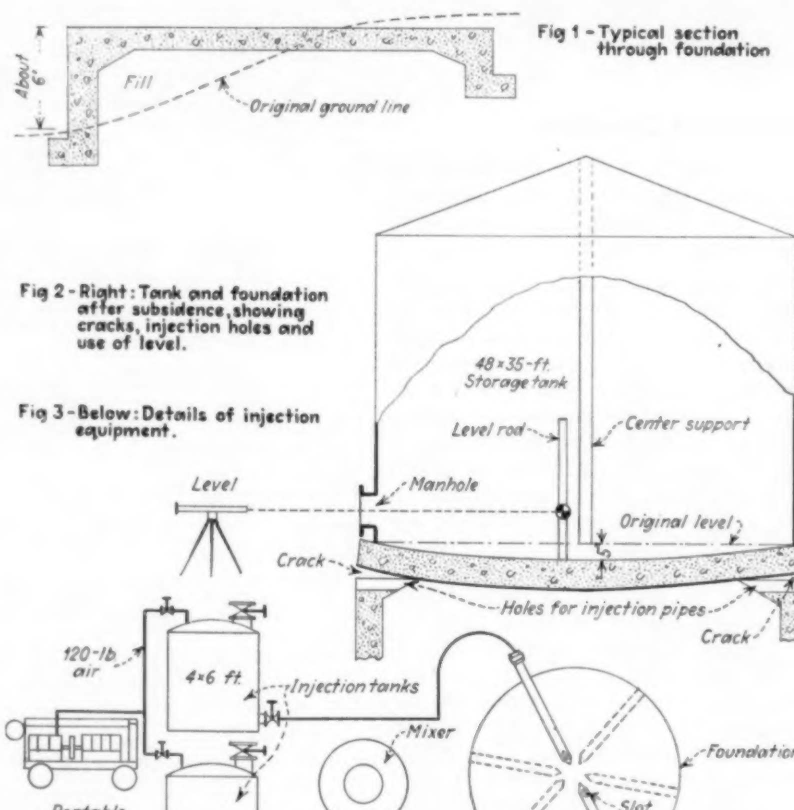


Fig 1 - Typical section through foundation

Fig 2 - Right: Tank and foundation after subsidence, showing cracks, injection holes and use of level.

Fig 3 - Below: Details of injection equipment.

Steps in levelling a dished tank foundation pad

Loam from the low land near the river accounted for the largest part of the grout. The mixture was approximately: 18 parts loam, 1 part portland cement, 1 part hydrated lime, 25 per cent water. The charging tanks were filled alternately with this grout mixture and it was forced under the pad with 120 lb. air pressure.

About one full day was required for injecting the grout. The horizontal and vertical cracks in the side wall of the foundation gradually closed up during the injection process, and the deformations in the lowest row of side plates and in the roof of the tank disappeared. A check with the level the next morning showed that the bottom of the tank had been raised to within $\frac{1}{4}$ in. of its original elevation.

Shortly after this the tank was placed in service and neither it nor the foundation showed any further signs of distress.

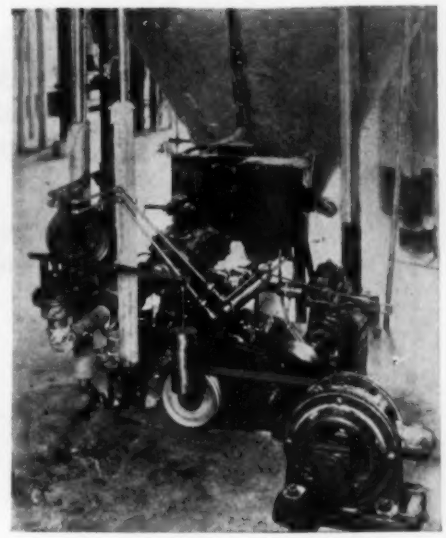
Variable Speed Transmission Controls Pressure

By F. A. Westbrook

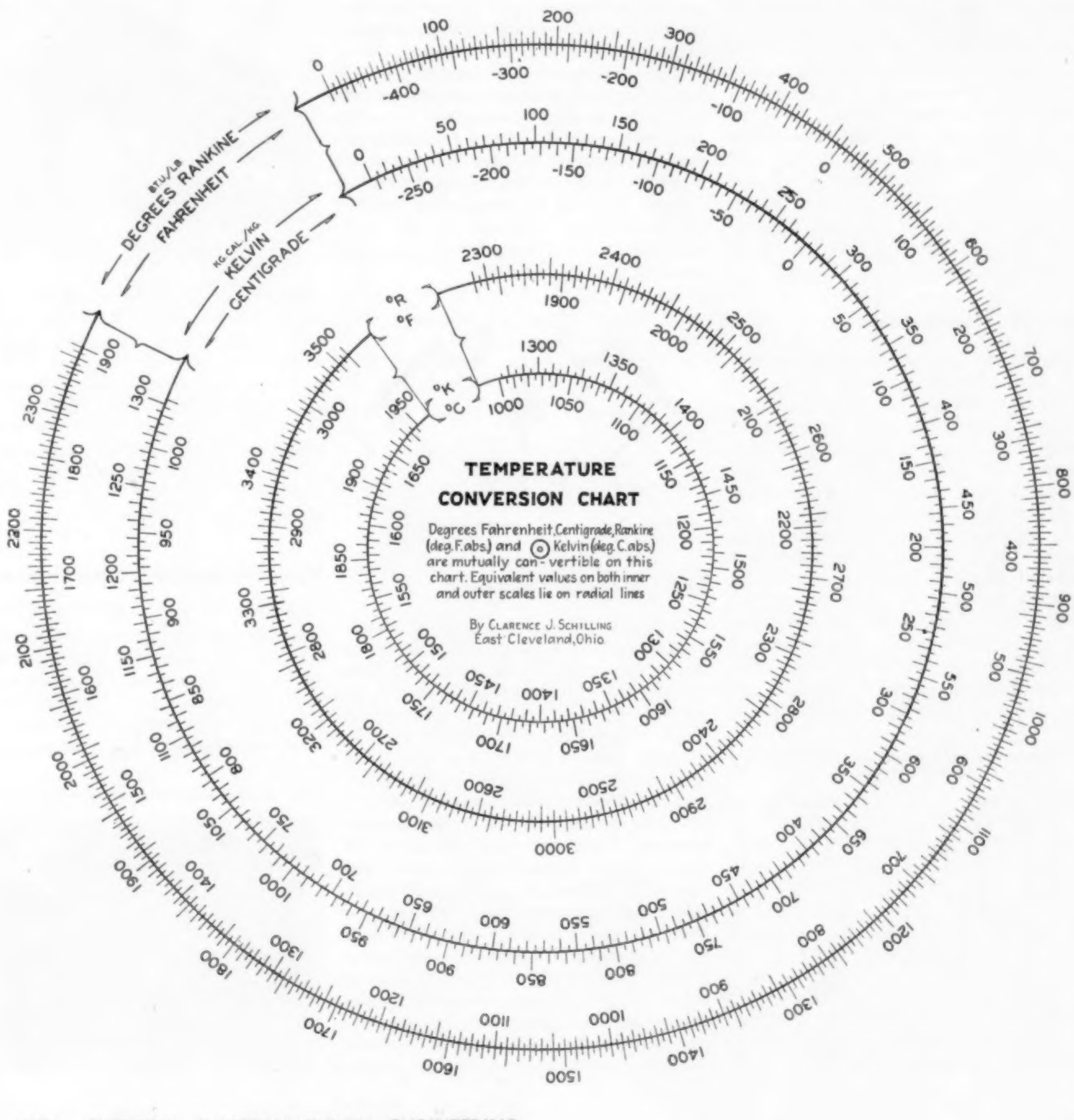
Center Conway, N. H.

An INTERESTING and ingenious method for holding constant pressure on the feed tanks of tooth paste tube filling machines has been worked out at the Hillside, N. J., plant of Bristol-Myers Co., by J. M. Knaudes, engineer of the company. For the filling machines to operate properly, a constant pressure of 40 lb. must be maintained. Consequently, the pump speed must be accurately controlled to hold this pressure, regardless of the number of machines that may be operating at a given time.

The illustration shows how this was accomplished by means of a Reeves variable speed transmission, controlled by a pressure responsive unit. The $1\frac{1}{2}$-hp., 1,200-r.p.m. motor drives the constant speed shaft of the Reeves through a triple V-belt, with a reduction to 500 r.p.m. The variable speed shaft is direct connected through a speed reducer to the pump so that the pump speed may be varied between 9 and 71 r.p.m. A plunger-type pressure regulator, counterbalanced with a weight, operates a pilot valve which in turn, through a hydraulic cylinder, controls the adjustment of the Reeves. Hence, when the pressure rises, the transmission is adjusted to reduce the pump speed. Similarly, the speed is increased when the pressure falls.



Pump speed control for pressure regulation



NEW EQUIPMENT

Explosion-Proof Lift

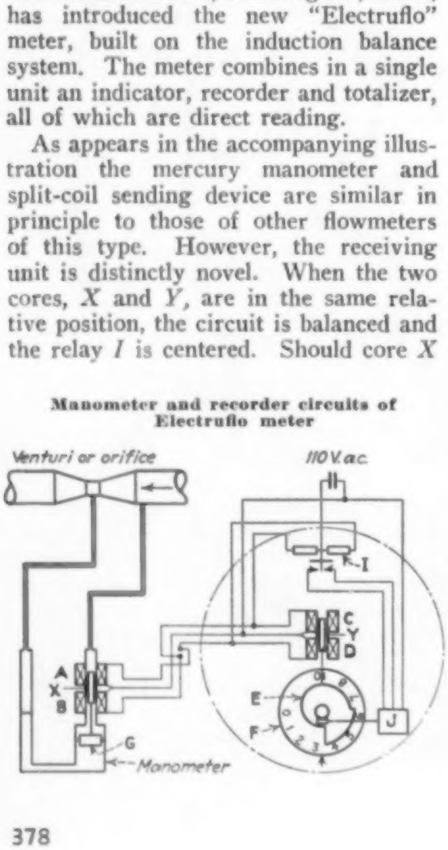
A new electric hoist, totally enclosed and equipped with an explosion-proof motor for use in Class I, Group D, hazardous atmospheres, has been announced by Electro Lift, Inc., 30 Church St., New York City. This lift is applicable to refineries, alcohol, methanol, acetone, and lacquer plants. In addition to its motor, the hoist employs an explosion-proof brake, controller and limit switch. Construction is of the broad flange type and is built in accordance with the standards of the Underwriters Laboratories for hazards of the types mentioned.

Electric Flowmeter

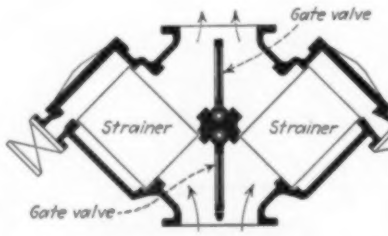
For measuring the flow of practically any fluid, Morey & Jones, Ltd., 922 South Hemlock St., Los Angeles, Calif., has introduced the new "Electruflo" meter, built on the induction balance system. The meter combines in a single unit an indicator, recorder and totalizer, all of which are direct reading.

As appears in the accompanying illustration the mercury manometer and split-coil sending device are similar in principle to those of other flowmeters of this type. However, the receiving unit is distinctly novel. When the two cores, X and Y, are in the same relative position, the circuit is balanced and the relay I is centered. Should core X move, the relay I becomes unbalanced, operating the motor J in such a direction as to move the cam E so as to return core Y to a position relatively comparable to that of core X. When this position is reached, the circuit is again balanced and the motor stops.

Manometer and recorder circuits of Electruflo meter



Cam E extracts the square root of the differential pressure and thus gives an evenly divided flow scale. Scale F, attached to cam E, serves as a flow indicator and also operates the pen arm. A simple motor-driven mechanism (not shown) operates the integrator, the integrator motor running during each half minute for a time directly proportional to the rate of flow.



Cross-section of Phillips strainer

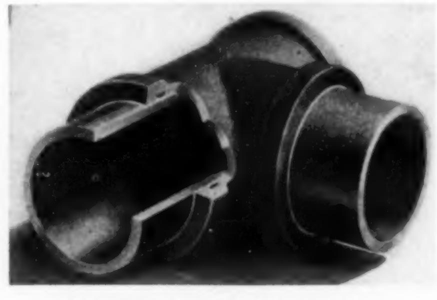
Self-Cleaning Strainer

Freyn Engineering Co., 310 South Michigan Ave., Chicago, Ill., announces the development of the new Phillips strainer for the cleaning of water in general service around the chemical plant. This strainer embodies a back-washing feature by means of which the strainer is cleaned while in operation, without removing the strainer baskets. The two baskets shown in the accompanying illustration are placed at 90 deg. to each other and are both used normally. When it is desired to back-wash, the lower gate valve is swung to close off one strainer. Water passing through the other strainer then discharges backwardly through the basket being cleaned, passing from the bypass valve and carrying with it the accumulated dirt. In a strainer handling 4,000 g.p.m. of Lake Michigan water, it was found necessary to back-wash the screens only once every eight hours of operation.

Strainer housings are made of cast iron for water pressures below 125 lb. per sq.in., and in cast steel for pressures up to 200 lb. The strainer may be mounted in any position.

Threadless Bronze Fittings

Through its collaboration with the Air Reduction Sales Co. and Handy & Harmon, the Walworth Co., 60 East 42d St., New York City, is now prepared to supply the new Walseal threadless bronze fittings, for use with standard iron-pipe-size and extra-heavy brass and copper pipe. As appears in the cutaway view, each opening of the fitting contains a ring of brazing alloy, known as Sil-Fos. Installing consists merely in sliding the pipe into the fitting and heating the joint with the oxy-acetylene flame until the brazing alloy appears as shown. Enough alloy is supplied so that the joint can be taken down once and made up a second time. Tests, it is stated, have proven repeatedly that the Walseal joint is stronger than the pipe itself.



Cutaway view of Walseal tee

Variable-Speed Transmission

What is known as the V.R.D. (variable roller drive) is a new self-adjusting, positive, variable-speed transmission for fractional horsepower duty announced by the Link-Belt Co., Philadelphia and Chicago. The new drive serves as a companion to the P.I.V. gear announced

Variable roller drive

several years ago for larger capacities.

The V.R.D. uses a side-contact roller chain consisting of steel links made endless and connected by hardened steel pins in hardened steel joint bushings. Each link contains two hard steel rollers which roll in contact with the hardened steel, conical, opposed disks forming the driver and driven wheels.

This drive will transmit $\frac{1}{2}$ hp. at maximum speed, with a maximum ratio of speed variation of 10 to 1.

Portable Weld Tester

For the testing of weld specimens on the job, the Air Reduction Sales Co., Lincoln Bldg., New York City, has developed a compact, portable testing machine for making both tensile and bend tests. The machine consists of an oil

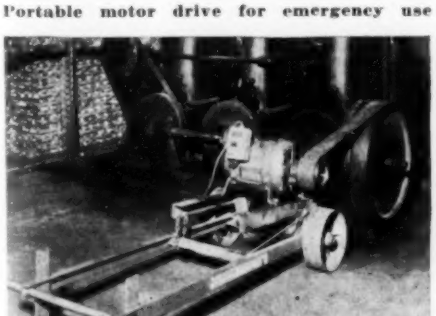
Portable tensile and bend tester

pump, a hydraulically-actuated piston or ram, and two heads, one fixed and one movable, for gripping the test specimen. The force on the pump lever is magnified 400 times at the test specimen. The load is indicated on a 6-in. pressure gage, calibrated against a standard.

Portable Drive

For emergency operation in case of motor breakdown, or where it is desired to run a single machine in a group without operating the others, the Rockwood Mfg. Co., 1801 English Ave., Indianapolis, Ind., has developed a port-

Portable motor drive for emergency use



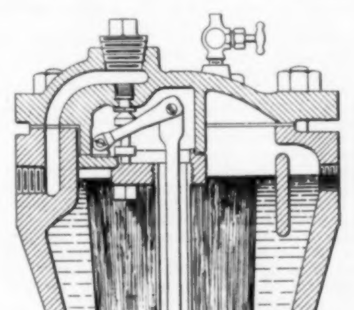
Electrically Heated Kettle Casing

Rockwool insulated metal casing for a 700 gal. kettle, heated electrically to 450 deg. F. The electrical energy, totaling 80 kw. at 220 volts, is applied to "folded and formed" furnace type elements, manufactured by the Harold E. Trent Co., which also constructed the casing.

able electric motor drive, which can be wheeled into place and be ready to run in five minutes. The equipment consists of a standard Rockwood drive (pivoted motor support) mounted on a truck. The device is adapted to short center driving because of its ability automatically to maintain tension of the belt through use of part of the weight of the motor. Drives of this sort employ motors ranging from 2 to 10 hp. in size.

Open-Bucket Trap

Nason Mfg. Co., 71 Fulton St., New York City, has announced the development of a line of open-bucket steam traps ranging in size from $\frac{1}{2}$ to 2 in. The two sizes below 1 in. are given the



Cross-section of open-bucket trap

name "Tiny" and the four sizes above 1 in., "Titan." The former are adapted to pressures up to 150 lb. and the latter up to 300 lb.

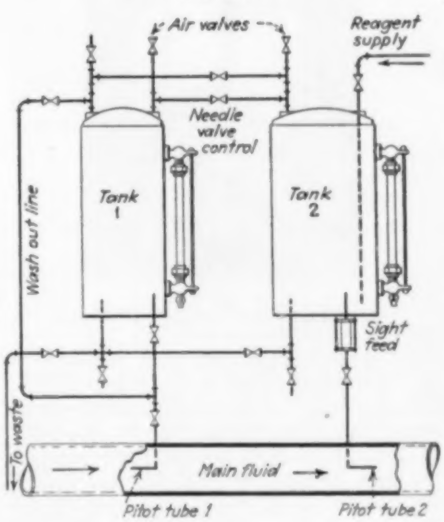
The accompanying illustration indicates the principle of operation. When condensate has risen to the bucket rim, it overflows and causes the bucket to sink. In so doing, the discharge valve is suddenly pulled open so that the steam pressure forces water through the center tube and out the valve, carrying ahead of it any air which may previously have been trapped in the tube. As soon as the bucket floats again, it rises and closes the discharge valve.

Chemical Feeder

A proportioning unit for accurately feeding predetermined quantities of liquids under varying flow conditions has been announced by D. W. Haering & Co., 3408 Monroe St., Chicago, Ill. The differential pressure between pitot tubes is the source of control, as indicated in the drawing.

Tank (1) is filled with a chemically inert, colored mineral base termed "red oil" which is lighter than either the main fluid or the reagent. Tank (2) is filled with the reagent. A proportionate amount of the main fluid enters pitot tube (1) and displaces some of the "red oil" through the needle control valve into tank (2). This forces reagent into the line through pitot tube (2). The rate of this displacement, which is ad-

New proportioning unit for reagent feeding



justed by the needle control valve, depends on the flow rate of the main fluid.

Since tank (2) is larger than tank (1), the red oil can never get into the main fluid line. Should the reagent become exhausted, only the main fluid will discharge from pitot tube (2). To recharge the apparatus, water is drained from tank (1) and reagent run into tank (2), thus returning the red oil to tank (1) at the same time.

Chrome Cement

Adachrome super-cement is the name of a new, improved chrome-base refractory cement recently put on the market by the Botfield Refractories Co., Swanson and Clymer Sts., Philadelphia, Pa. The cement is said to be extremely smooth and plastic, free from shortness and workable even on refractory insulating brick which quickly absorb moisture from bonding mortars. It is further claimed that the component materials will not settle in the drum or mortar box, but will remain in suspension indefinitely. The material is stated to develop a strong air set within a short time after application, without the use of a silicate binder. The pyrometric cone equivalent, according to tests, is cone 38, corresponding to a temperature of 3,335 deg. F.

1500-Lb. Experimental Process-Steam Boiler

In order to use saturated steam at a temperature of 575 deg. F. in a particular process, a large manufacturer has recently installed the experimental boiler shown herewith. This boiler, built by the Combustion Engineering Co., New York City, consists of a single row of tubes entering top and bottom headers which are connected by a single downcomer. The boiler is gas-fired and the furnace (not yet bricked in) is a simple refractory-lined chamber.

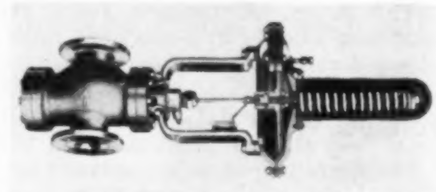
Manometer Regulator

For the control of liquid level, differential pressure and other variables, the Meriam Co., 1955 West 112th St., Cleveland, Ohio, has introduced a contact-making mercury manometer. This consists of two glass tubes gasketed at their lower ends into an iron block, and containing in the upper ends Bakelite plugs through which run adjustable tungsten wires for making contact. One terminal is also provided in the block.

The new instrument is said to be unusually rugged and simple, and to retain permanently its accuracy under severe service conditions. It presents the additional advantage of making the differential visible at all times.

Improved Control Valve

To eliminate friction and to make possible a uniform valve characteristic over almost the entire opening range, The Foxboro Co., Foxboro, Mass., has introduced the improved Stabilflo valve for automatic control applications. The valve differs in a number of respects from its predecessors, particularly in the fact that the usual positions of the diaphragm and spring have been reversed. By placing the spring above the diaphragm, it is possible to protect it from corrosion and to do away with guides, so that the only possible friction



New Stabilflo control valve

is in the stuffing box. This, it is stated, has been reduced to the minimum by the use of a valve stem lubricator. The port construction used in new valve gives equal percentage flow characteristics between 2 and 100 per cent valve capacity, which is described as a rangeability of 50 to 1, said to be five times that of other valves.

MANUFACTURERS' LATEST PUBLICATIONS

Bearings. Bantam Ball Bearing Co., South Bend, Ind.—General catalog on tapered roller bearings with engineering data and detailed listings on over 1,500 bearings.

Blowers. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 120-B10—4 pages on centrifugal blowers and exhausters in capacities to 8,000 cu.ft. per min., at pressures up to 3 lb.

Chemical Recovery. Combustion Engineering Co., 200 Madison Ave., New York City—Leaflet describing the Murray-Waern system for the recovery of chemicals in soda and sulphate mills. The system incorporates waste heat recovery, using water-cooled furnace walls.

Compressors. Pennsylvania Pump & Compressor Co., Easton, Pa.—Bulletins 104 and 223—Respectively 4 pages on air compressor air cushioned valves and 12 pages on close-coupled centrifugal pumping units.

Dust Collectors. Pangborn Corp., Hagerstown, Md.—Bulletin 197—24 pages of detailed description and information on installations of this company's Type CH all-metal, cloth-screen, dust collector.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—GEA-1837—78-page reference book with engineering data and tabular material on the selection of insulated cable. Also GEA-1913, 2 pages on the Pyrotip electric burner, and GES-1012, 14 pages on advantages of power-factor improvement equipment.

Electrical Equipment. Roller-Smith Co., 233 Broadway, New York City—Catalog 10—5 pages on a new electronic out-voltage regulator made by this company; Catalog 123, Price Sheet 7: covers a new line of portable voltmeters, ammeters and wattmeters.

Electroplating. R. & H. Chemicals Department, E. I. duPont de Nemours & Co., Wilmington, Del.—15-page operating manual for copper, brass, bronze and zinc plating with this company's copper and zinc cyanides.

Equipment. Consolidated Products Co., 15 Park Row, New York City—Issue of Consolidated News, a monthly newspaper, dealing with used chemical equipment offered by this company.

Equipment. J. H. Day Co., Cincinnati, Ohio—Bulletin 104—12 pages illustrating and describing Day Hunter sifters and mixers.

Equipment. Fairbanks, Morse & Co., Chicago, Ill.—28-page book entitled "More Than a Century of Progress," commemorating 104 years of this company's manufacturing experience and illustrating its various products.

Gaskets. Thiokol Corp., Yardville, N. J.—Reprint of an article describing the use of Thiokol joint gaskets in cast iron pipe for gas distribution.

Hoists. Ingersoll-Rand Co., 11 Broadway, New York City—Bulletin 12107—32 pages on single and double drum Utility air hoists.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 534—4 pages on the use of recording instruments in keeping down power bills.

Insulation. Johns-Manville, 22 East 40th St., New York City—Folder IN-28-A—4 pages on new 1,900-deg. Superex insulating blocks made by this company.

Metals and Alloys. Ampco Metals, Inc., South 39th and West Burnham Sts., Milwaukee, Wis.—Catalog 20—32 pages with physical properties and data on uses of several grades of Ampco metal and Atlas bronzes made by this company.

Power Transmission. Link-Belt Co., 910 South Michigan Ave., Chicago, Ill.—Catalog 1415—32 pages with engineering data on herringbone-gear-type reduction units.

Valves. The Edward Valve & Mfg. Co., East Chicago, Ind.—Bulletin 11-T—48 pages on boiler non-return valves.

Valves. Jenkins Bros., 80 White St., New York City—12-in. cut-out replica of one of this company's standard iron body gate valves with information on important features.

Valves. The Lunkenheimer Co., Cincinnati, Ohio—10 pages on Causul Metal gate valves and indicator cocks with extensive information on corrosion resistance of the alloy used.

Welding. Linde Air Products Co., 30 East 42d St., New York City—Booklets of 8 and 12 pages, respectively, covering the oxyacetylene welding of corrosion-resisting steels and the design of jigs and fixtures.

Winders. Cameron Machine Co., 61 Poplar St., Brooklyn, N. Y.—Form TPN-534—4 pages describing advantages of the roll winders for paper, manufactured by this company.

NEWS OF THE INDUSTRY

Chemical Engineering Equipment Code approved. Technical Resource surveys form part of Federal program with studies on Power, Minerals and Water included. Progress reported in standard activities of T.V.A. Hearing revealed that synthetic camphor supplied 35 per cent of domestic requirements in first five months of this year.

Engineers Will Conduct Economic Conference

PLANS for a nine day mid-summer conference of engineers on problems related to industrial recovery and reconstruction were announced today by President Harvey N. Davis of Stevens Institute of Technology. The sessions of the Fourth Annual Economic Conference of engineers will begin on Saturday evening, August 11, and will continue through Sunday, August 19, during which period there will be twenty-five scheduled meetings having as their general theme "An Economic Appraisal of the New Deal." As in previous years, the Conference will be held at the Stevens Engineering Camp at Johnsonburg, in Northern New Jersey.

This annual conference, initiated in 1931, has had as its sponsors engineering alumni associations of Brown, Columbia, Cornell, Harvard, Massachusetts Institute of Technology, Princeton, Rensselaer, Stevens, and Yale; also the American Society of Mechanical Engineers, the American Institute of Chemical Engineers, and the American Association for Adult Education. Approximately one hundred graduates of twenty-eight colleges of engineering attended the conference of 1933.

Seminars, lectures, and panel discussions are scheduled for forenoons and evenings of the conference period. No formal sessions are scheduled for the afternoons, which, in general, will be kept free for recreation.

Executive officers of industrial corporations, members of the faculties of economics in several universities, and officers of some of the federal agencies of recovery and reconstruction compose the list of visiting lecturers and conference leaders. At the final session, Sunday evening, August 19, General Hugh S. Johnson, NRA Administrator, will speak.

Permanent Code Authority For Machinery Industry

NATIONAL Recovery Administrator Hugh S. Johnson has approved the method of selection and recognized the personnel of the permanent basic Code Authority for the machinery and allied products industry.

The members are: W. S. Shipley, president, York Ice Machinery Corp., York, Pa.; W. C. Dickerman, president, American Locomotive Co., New York; Leo W. Grothaus, assistant to the president, Allis-Chalmers Mfg. Co., Milwaukee; Paul C. De Wolf, vice-president, Browne & Sharpe Mfg. Co., Providence; P. C. Brooks, executive vice-president, Fairbanks, Morse & Co., Chicago; George P. Torrence, president, Link-Belt Co., Chicago; N. W. Pickering, president, Farrel-Birmingham Co., Ansonia, Conn.; Robert E. Friend, president, Bordberg Mfg. Co., Milwaukee; George H. Houston, president, Baldwin Locomotive Works, Philadelphia; A. M. Mattison, president, Mattison Machine Works, Rockford, Ill.; Guy A. Wainwright, president, Diamond Chain Mfg. Co. Indianapolis; and Denis F. O'Brien, president, A. P. Smith Mfg. Co., East Orange, N. J.

Foundation for Inventors Established at New York

CONTRARY to accepted theories that successful inventors are gifted by fate or born under a lucky star, an Inventors Foundation newly inaugurated with headquarters in the Chanin Building, New York, is announced prepared to instruct, guide and counsel inventors. The sponsor of this unique venture is Henry J. Gaisman, chairman of the board of the Gillette Safety Razor Co., and originator of the Autographic camera, safety razors, blades, and the machinery for making them, as well as many other inventions.

The new organization is created to fill the gap existing between the inventor, the Patent Office and the inventor's ultimate market. It is designed to provide a clearing house for inventors' problems and an unbiased source of information on the sound business aspects of invention. It is equally prepared to counsel executives who have company problems regarding new products, or the layman with an original idea who is lost in his efforts to commercialize it. The institution is strictly educational and does not interest itself financially in any invention.

American Cyanamid Acquires Burton Explosives

AMERICAN Cyanamid & Chemical Corp. announces the acquisition, effective July 1, of the plant, properties, and business of Burton Explosives, Inc., Cleveland, Ohio, which company has since its organization in 1930 been engaged in the manufacture and sale of high explosives and blasting supplies.

The explosives plant, covering 415 acres, is located at New Castle, Pa., with a capacity of 18,000,000 pounds annually. The plant is complete for the production of commercial high explosives and is designed to prepare and manufacture a number of the raw materials used. Plant and processes are the result of the long experience of Mr. Burton and his associates.

S.P.E.E. Meeting Again Features Chemical Engineering

Special Correspondence

THIRTY chemical engineering teachers representing 22 institutions were in attendance at the conferences held at Cornell University in Ithaca, June 19 to 24, in connection with the 42nd annual session of the Society for the Promotion of Engineering Education. Not since the meeting in Ann Arbor in 1931 has chemical engineering education had such specific interest on the part of S.P.E.E. Thirteen papers were presented on methods for teaching the unit operations of chemical engineering, and there were eight other papers in the various joint sessions dealing with heat transfer and fluid mechanics.

The conference on teaching methods was attended by an active group of younger men interested in advancing present teaching practices and in keeping in touch with future trends in chemical engineering in industry. Discussions in connection with the formal papers were of a definite chemical engineering nature, good points as well as defects of present practices being brought out and suggestions for improvements requested. The influence of geographical location, institutional standards, personnel of instruction, availability of funds, industrial contacts and research opportunities were prominently featured. Considerable emphasis was placed on the influence of the work of the committee on chemical engineering education of the American Institute of Chemical Engineers.

The formal papers presented at the conference were as follows:

1. Resumé of Chemical Engineering Education in the Colleges and Universities. By Frank C. Vilbrandt, Iowa State College.
2. Contributions to Chemical Engineering Unit Operation Courses. By J. C. Elgin, Princeton University.
3. Curricular Placement of Chemical Engineering Unit Operation Courses. By J. H. James, Carnegie Institute of Technology.
4. Chemical Engineering Applications of Fluid Mechanics. By J. H. Koffult, Ohio State University.
5. Heat Transfer and the Phenomenon of Evaporation. By W. L. Badger, University of Michigan.
6. Heat Transfer Phenomenon of Condensation of a Mixture of Condensible and Non-Condensible Gases. By O. A. Hougen, University of Wisconsin.
7. The Trend in Requirements for Teachers. By F. C. Vilbrandt, Iowa State College.
8. Methods Used for Presenting Class Material in Process Course. By F. C. Vilbrandt, Iowa State College.
9. Method of Presenting Course in Organic Technology Course. By R. Norris Shreve, Purdue University.
10. Squad Teaching of Unit Operation Laboratory. By H. A. Webber, Iowa State College (read by F. C. Vilbrandt).
11. Student Demonstration Method. By L. A. Stout, Washington University (read by F. C. Vilbrandt).
12. Co-Operative Course at Drexel Institute. By R. P. Kolb, Drexel Institute.
13. Comprehensive Problems. By O. A. Hougen, University of Wisconsin.
14. Ch. E. Laboratory Notebooks and Texts. By S. C. Ogburn, Bucknell University (read by R. J. Kintner).
15. Research Opportunities and Graduation Work. By F. C. Vilbrandt, Iowa State College.

General Discussions

The discussion under the leadership of J. C. Elgin centered around chemical engineering education in general, and specifically on parentage of unit operations courses, length of the curriculum, and the teaching personnel of courses in economics, modern languages, general chemistry and mathematics. Prof. J. H. James led the discussion of teacher training, selection of teachers based upon institutional ratings, attendance of teachers at meetings. W. W. Hodge directed thought along lines of methods of teaching lectures and applicability of various accessories in handling lecture material. M. C. Molstad dealt with materials presented in seminars and on attendance at student organization meetings.

The discussion under the leadership of J. H. Koffult brought out the activities at Ohio State, Carnegie Tech., University of Louisville and at Georgia School of Technology in the construction of new laboratories and increased equipment in the unit operations laboratories. F. C. Vilbrandt discussed the general conformity of practice in squad teaching, i.e., the use of one instructor to each twelve students.

From the paper by L. A. Stout came the suggestion that the student demonstration method merited serious consideration where curtailed budgets inflicted serious inhibitions on the teachers. The use of summer terms for full-day laboratory courses was discussed. The discussion on research opportunities developed into a criticism of the incompleteness of the report on graduate standing of the American Council of Education.

The discussions under the direction of O. A. Hougen were directed toward the fact that cooperative instruction was applicable at institutions in proximity to industrial areas, but inapplicable to institutions in rural communities. Also, that a comprehensive problem method of examination was more desirable if given over an extended period, than if given orally.

The discussion under the leadership of R. J. Kintner on the value of laboratory texts and notebooks brought favorable comment on the activities of S. C. Ogburn, who was appointed by the group to act as chairman in the assembly material for the above purposes.

The discussions under the leadership of R. Norris Shreve centered about the difficulties of placement, the activities of alumni in contacting industry, the personnel of student bodies, and the industrial contacts of teachers.

Bureau of Mines Acquires Large Helium Reserve

THE acquirement of all gas rights in 50,000 acres comprising the Cliffside helium-bearing gas field, near Amarillo, Texas, has been completed by the United States Bureau of Mines. This field supplies the raw material from which all helium used by the Nation's military service is extracted in the Amarillo Helium Plant, designed, built and operated by the Bureau of Mines. In addition to supplying current requirements, the field provides a large reserve for future lighter-than-air craft operations of the Army and Navy.

When production and conservation of helium for Governmental use was delegated by Congress to the Bureau of Mines in 1925, the old supply was failing and extraction costs were high. From the World War period, when members of its staff suggested production of helium for aeronautical use by the Army and Navy and directed experimental work to develop processes for its extraction, the Bureau of Mines has continued its studies of helium. Through these studies the area now known as the Cliffside field was found to contain gas of about 1¾ per cent helium content.

With the responsibility of providing helium placed upon it by the Congress, the Bureau of Mines made a thorough study of the Cliffside field and considering all factors, determined that this field was the best reserve of helium-bearing gas then known. No comparable field has ever been discovered.

Production of helium at the Amarillo plant was started in April, 1929. In five years of operation, this plant has produced more than 57,000,000 cu.ft. of helium, or about one-half of all of that element ever recovered in the world. Operating costs have been less than one-third of the lowest cost at which helium was ever obtained by the Government from any other source.

Chemical Progress Reported at Meeting of German Society

From Our Berlin Correspondent

At THE general meeting of the German Chemical Society, in Cologne, some addresses of general interest were made. It may be stated that due tribute to the government for its relation with the chemical industry was made in a number of speeches.

Prof. Ubbelohde of Berlin discussed the German petroleum program. Increase in mineral oil supply from domestic sources is to be effected by: (1) promotion of drilling oil wells; (2) increase in hydrogenation plants; (3) a greater production of mineral oils by coal distillation, for instance by the Still process frequently referred to in these columns; (4) low-temperature distillation of coal; (5) distillation of lignite. The fact that the diesel engine is making rapid strides at the expense of the gasoline motor is having an important bearing on the petroleum question, and the production of fuel will naturally be affected accordingly.

Bergrat Lichtenberger of Stuttgart talked on the gasification of fuel by a bath of fused salt. One of the purposes of the salt bath is to serve as a means of separating the fire gases from the gases generated from the fuel. The new process is derived from the lean-gas producer which offers the advantage of continuous and almost complete gasification of the fuel, but which, however, has the disadvantage of producing a gas of poor quality due to admixture by the gases of combustion. The salt bath, on the other hand, penetrates the fuel, subdividing and separating it from the ash-forming components, while the superheated steam introduced completely gasifies the fuel components liberated by the salt bath, whereby the tar vapors formed are said to be cracked and the resulting carbon dioxide reduced by the liberated carbon and the coke particles. The even temperature of the salt bath also insures an equally even composition of the gas. These tests have been carried out on a larger scale at the Heilbroun salt works. After a certain running time the contents of inert components in the gas was brought down to a few per cent.

Dr. Hartner - Seberich, Mülheim-Ruhr, discussed the operation of heavy vehicles with suction gas, particularly with a new lignite briquet gas producer. Tests have been made under the auspices of Kaiser-Wilhelm Institute für Kohlenforschung, to operate heavy trucks with lignite briquets. Such briquets when carbonized are an excellent fuel. But as such carbonized briquets are not available in large quantities at the present time non-carbonized briquets were treated in an installation which delivered a practically tar-free gas even with a small load on the gas producer, and made it possible to operate without formation of slag. The gas producer is constructed from metallic materials, the briquets are decarbonized in the gas producer itself, before they are placed on the grate. Dust and ash are carefully removed from the gases. The firing zone of the producer is fed from two points, through a central main air injector and an auxiliary injector at the periphery. Through the suction of the main injector the distillation vapors are furthermore drawn in and mixed with the gasification air whereby the dangerous slagging is suppressed. A series of successful trips were made with a 1.5-ton delivery truck.

Synthetic lubricating oils from condensation products of ethylene has been produced by Dr. Schildwächter, Dresden, by the action of ethylene at 60 atmospheres and about 100 deg. C. on naphthalene and tetralin in the presence of aluminum chloride. A good yield of lubricating oil was also obtained from coal tar distillate at 310 deg. C. In spite of low molecular weights these products possess high viscosity. The lubricating oils are free from asphalt, asphaltic compounds and have a very low solidifying point. These products also behave satisfactorily when oxidized, as far as formation of sludge is concerned.

Widdecke has succeeded in obtaining lubricating oil, paraffin, and asphalt from German petroleum residues by treatment with amyl alcohol at 0 deg. C. By this treatment lubricating oils are extracted by selective solution, for instance in aqueous amyl alcohol, paraffines and asphalts are separated and heated with amyl alcohol to 50 deg. C., whereby the paraffin is dissolved leaving the asphalt. Amyl alcohol is removed from the three separated products and lubricating oil of good quality and low-solidifying point is obtained with a yield of 30 to 60 per cent according to the material used, also paraffines with melting points from 55 to 60 deg. C., and asphalt.

The Milaco process of Michael Barthel & Co., Regensburg, is a high-vacuum distillation of dark wood rosins, in which is obtained an almost pure abietic acid with a melting point of 80 deg. C. Starting with a raw balsam rosin, a refined rosin, almost clear as water, is obtained. It is soluble in gasoline and in alcohol; the dark-colored residual rosin is almost completely soluble in alcohol. The turpentine oil boils at a temperature of 35 to 40 deg. C. in the high-vacuum distillation, its odor is consequently not impaired; furthermore, no harmful reduction of the pinene content, so important in the production of camphor, takes place.

Of particular importance was the paper by Mietzch, who in collaboration with Dr. Mauss has produced atebrin, an acridine compound which is particularly effective against malaria. The formerly known amino-acridines as well as the trypaflavine and rivanol, in spite of other valuable chemico-therapeutical properties, are not effective against malaria. By introduction of basic side chains compounds effective against malaria are produced, particularly atebrin, which has the same fundamental effects as quinine, but which, on account of its stronger action and non-toxic properties is superior to the natural product.

Coincident with acridine compounds are derived for which Dr. Gleu has found interesting chemico - luminescent phenomena. These are dimethyl-diacridylium salts, which in alkaline solution show green to whitish blue light when acted upon by hydrogen peroxide. This light is greatly intensified by catalytic action of osmium tetroxide. The luminescent reaction is characteristic for hydrogen peroxide. Luminescence is only produced by the presence of molecular oxygen and does not take place when the solution first is freed from oxygen by pure nitrogen. It must be assumed that this luminescent reaction must be fundamentally related to the biological luminescent phenomena in oxidizing reactions.

A new method for chemical purification of waste water, the iron-carbon dioxide process, has been developed by Dr. Jung, of Viersen. In this process the waste water is treated with carbon dioxide in the presence of metallic iron, whereby iron is dissolved as iron bicarbonate. The dissolved carbon dioxide is then expelled from the water by strong aeration, the iron bicarbonate is oxidized and the hydroxide coagulated together with the impurities in the water. As a source of carbon dioxide may be used waste gas with about 10-15 per cent CO_2, for instance flue gas or exhaust from a gas engine; as a source of iron may be used turning from a machine shop. The total time required for treating the waste water is 30-45 min.

TARIFF experimenting is loaded with potentialities for harm for the chemical industry, in the opinion of representatives of the industry who have been following developments closely. This conclusion is based upon the fact that the industry, in many of its branches, is new and enjoys a relatively large amount of protection, and that the United States is relatively a high-cost producer due to higher wage scales and higher salaries to technical personnel.

In this connection, however, it is pointed out that the industry has an impressive list of accomplishments to show for the degree of protection granted. The growth of the organic chemical industry since the world war has been at a phenomenal rate and has continued throughout the period of depression. It has been chiefly responsible for the breaking up of great foreign monopolies, such as that which formerly controlled nitrate of soda, to the great benefit of the American consumer.

Since it is understood to be the policy of the tariff negotiators to handle the big pieces first, and since it is known that studies are being made of the quantity-production industries, it is expected that efforts also will be made to pave the way for increased exports of such chemical products as ethyl alcohol, soda ash, caustic soda, paints, cosmetics, medicinals, baking powder, starch, and naval stores. It is known that efforts are being made to ascertain the particular barriers that are keeping such products out of markets in which the American producers otherwise should be able to win a share of the business.

Chemical Interests Oppose

While Francis B. Sayre, Assistant Secretary of State, and George N. Peek, the President's commercial adviser, are working out policies, representatives of the chemical industry are preparing to oppose reductions in present rates of duty and to be in a position to provide promptly any information for which the government may call. No application has been made to appear at the Cuban hearing scheduled to begin July 23. It is felt that the main issue in that hearing will be sugar and that the interchange of chemicals between the United States and Cuba is too small to come in for consideration in connection with the proposed new treaty.

It is the intention to call forcefully to the attention of the government's tariff negotiators the public benefits which have resulted from and promise to accrue from the research work done by the chemical industry. The progress that has been made in the United States as a result of the research work of the chemical industry has added materially to employment and has been of great benefit to consuming industries and to the

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

consuming public. As an example of future benefits likely to result from research work, the experiments of Dr. Charles H. Herty on southern slash pine are being cited. If the present promise of those experiments is realized, it will mean large-scale employment, the improvement of the economic situation of a large and important section of the country with great benefits to industries now dependent upon foreign sources of supply.

Attention also will be called to the danger of entering into an agreement affecting any important chemical product, since in chemistry more than in any other industry there is an interrelationship between products which would make possible unlooked for and far-reaching effects. More than that, a tariff concession would be extended automatically to the long list of countries entitled to most-favored-nation treatment from the United States. This likely would mean, the State Department will be told, an impouring from many sources of unsuspected volume of imports.

T.V.A. Activities

Dr. Arthur Morgan, TVA chairman, has a spirited rebuke for the coal industry's truculent attitude regarding hydroelectric power development in the Tennessee Valley. It is almost a crime to use coal for power, according to the Doctor, who predicts that the human race shortly will "live on" its byproducts, to wit: furniture, carwheels, insecticides, photosynthesis. Particularly did Dr. Morgan stress the many chemical processes in which heat is essential.

Dr. Morgan reports that dam construction, housing, fertilizer, and other "standard" activities of TVA are doing well, but that other possibly more ambitious aspects of its program, such as the decentralization of industry, in which it was hoped that private capital would dedicate itself to the TVA ideal, are not panning out so well. But the zealous Dr. Morgan is also resourceful. He's playing with the idea now that, if TVA can't induce private industries to spread out through the Valley, the Valley people can manufacture in their own homes, "parts" to be supplied to outside industries.

Split shingles, singletrees, and ceramic products are mentioned by Dr. Morgan because Valley folk have surprised him by their adeptness in turning out these articles. Farm workshops would be mechanized for this purpose, and Dr. Morgan anticipates that such operations would be quite as efficient as mass production in factories. He expects to sound out the RFC to find out whether Valley cooperatives can obtain loans for this purpose under the new loans-to-industries act.

Labor employed by TVA is showing gratifying zeal, individually and collectively, according to Dr. Morgan. He recites with enthusiastic gusto evidences of their keen sense of responsibility and desire for self-expression. They have cut across the company union vs. outside union issue by organizing not in horizontal craft unions, but in a vertical union, which they have asked the A. F. of L. to charter.

Synthetic Camphor Tariff

Synthetic camphor supplied something over 35 per cent of the domestic requirements for camphor during the first half of this year. Hence under the Tariff Act of 1930, the present duty of 5 cents per lb. on refined camphor continues another year. If the domestic requirements had been supplied to the extent of less than 30 per cent by domestic synthetic production, the tariff under that act would have reverted to the same level as for crude camphor, one cent per lb.

Complete data for the precise six months involved in this adjustment, mainly December 18 to June 17, both dates inclusive, have not been made available. But domestic consumption of synthetic camphor during the period December 18 to May 31, was in excess of 826,000 lb. and the consumption of natural camphor approximately 1,394,000 lb. for the first five months of 1934, with an estimated consumption of 258,000 lb. in June.

From these data it is estimated that the ratio of synthetic to crude natural camphor used has declined somewhat from the preceding year, but approximated the ratio of 6 to 10 this year. A year from now to continue the higher duty, domestic synthetic material must supply 60 per cent of domestic consumption. If that level is reached, then the higher rate of duty continues indefinitely without further limitation as to ratio.

A group of comprehensive fundamental studies, substantially free from preconceived bias as to findings, appear under way. As the plans for these surveys develop, it is evident that the President is going to have within the next

year or two a very elaborate factual basis on which to formulate natural resource policies.

Rosin Standards

Changes in United States Rosin Standards are now under way at the Department of Agriculture. Said to have the backing of both producers and consumers in the naval stores industry. Department officials are sounding out sentiment as to how revisions should be made.

Convinced that the present glass rosin standards are not regularly and logically spaced on the color scale for rosin colors, the Food and Drug Administration of the Department, which has charge of enforcement of the naval stores act, has learned that glass makers are now able to produce a product more suitable for the grading purposes than that now used. Color quality or brightness in the present glass standards is lower than in clean well-strained rosin, they insist. Reduction of the 12 color grades now used to 8 is also under consideration.

At a meeting held in New York City with representatives of the trade, Department officials said they found no opposition to the proposed revision. They claim the following advantages, which they state the trade recognizes, for the proposed changes: 1. higher brightness comparable with well-strained rosin; 2. a color composition more like that of rosin; 3. more regular spacing of grades; 4. a full $\frac{7}{8}$ inch aperture with no interfering border; 5. improved methods of assembling standards; 6. pressed glass surface rather than a wavy glass; 7. reduced cost of a set of standards.

Spacing of the new standards and the proposed elimination of certain grades to reduce the number remains at question. Sentiment in the industry on these questions is to be sounded in a circular letter the Food and Drug Administration is now preparing.

Loans to Industry

If direct loans to industry are to provide employment on a large scale by winter it has become evident that many large advances must be made promptly. The RFC may not loan more than $500,000 to a single applicant but by participating to that extent in loans to which the Federal Reserve and private banks may be parties, it will be possible to make large single loans that will result in the employment of a large number of persons.

This does not mean that there will be any neglect of applicants for small loans. Inquiries that have been received indicate that there will be a large number of such loans. It already is apparent, however, that no loan can be made without time-consuming investigations and negotiations. Less time is required for negotiations in making a large loan than for a small one. If the main purpose of the law to "maintain and increase employment" is carried out promptly, chief reliance must be placed in large loans.

While the flow of applications from the regional agencies of the RFC to Washington headquarters is not expected to begin until next week (week of July 16) enough is known of the character of the applications to know that a large percentage of the small loans, either are not eligible or apparently are not eligible. Applications in the latter category have to be investigated and passed upon. While none of the prospective large loans have reached the application stage, it is known that when they are submitted most of them will be in finished shape.

By far the greater part of the applications that have reached the local agencies involve refinancing. Under the requirement of the law concerning the creation of employment the RFC will not entertain an application for a loan for debt readjustment. There may be an occasional case where some adjustment of outstanding debts may be allowed but it will have to be an incidental and not a principal purpose of the loan. As the RFC will not take a second lien on property there may be cases where some payment on an outstanding debt may be made as an inducement to the debtor to subordinate his claim to that of the RFC.

Mortgage Loan Conversions

The first money to be put out under the act will go to concerns that have been granted mortgage loans under the old act. Some of these concerns can be better served under the direct-loans act. The RFC is encouraging these conversions under such circumstances. They involve such enterprises as lumber manufacture, automobile appliances, furniture making, upholstering, and contracting.

Next in volume to the inquiries which involve debt refunding come those which suggest willingness to borrow for capital expenditures. As in debt refunding no capital expenditure will be allowed unless it is entirely incidental and essential to the carrying out of the principal purpose of providing operating capital. It is pointed out, however, that operating capital furnished a manufacturer of machinery, for instance, may make it possible for him to make terms or arrange for private credit that will allow another recipient of a direct loan to install needed equipment. The RFC will loan only where direct employment results. It will not loan to a merchant for the purpose of buying goods, although that order would produce employment indirectly. The RFC prefers making its loan to the manufacturer directly who would be the employer of the force that would be "maintained or increased."

No direct loan money will be available for new enterprises, regardless of their soundness. Loans are to be made only to going concerns established prior to January 1. This is not understood by many who want loans. One carefully worked out plan for a meat packing plant was submitted. There was no plant of the type in the area. Under conditions that have arisen under AAA regulation there seems little doubt that the project is sound and would likely succeed, but it is entirely ineligible for a RFC loan.

Loans will not be made to insolvent concerns or those of doubtful solvency. This also is not generally understood, as inquiries are being received from a large number of such companies. No loans will be made to promotional enterprises or to those desiring to exploit new products. The RFC will not finance expansions of any character.

Loans to Contractors

Loans to contractors will cover only operations actually under contract.

1. Power. By National Power Survey under the Federal Power Commission.

2. Minerals. By Planning Committee for Mineral Policy, a special agency with Secretary Ickes as chairman and Dr. C. K. Leith as vice-chairman.

3. Land. Partly through a group of separate agencies not yet fully coordinated. One deals with erosion prevention, one with soil fertility, one with submarginal land retirement, and others with additional specialized themes. Necessity for urgent attention to drought matters has, of course, diverted attention from the long-time planning and inquiry phases of this subject. A land planning committee, largely within the Department of Agriculture, is contemplated but this has not been given full power for functioning on a broad scale as the other projects previously named. It will, however, presumably ultimately absorb them, perhaps after extensive reorganization.

4. Water. A tentative study, at present only in contemplation, by National Planning Board. This is much more elaborate than the definite program for waterway development on which N. P. B., under the direction of Mr. Frederic A. Delano, is actually embarking. In its full form, it will deal with all types of water utilization, treating water as a national resource.

5. Forests. This subject will be studied through the Forest Service with a view to coordinating a long-time forest plan, favored by the Department of Agriculture, with the water supply, land, and agricultural activities of the administration.

Production of Synthetic Rubber in Russia

According to Bureau of Commerce report one of the important industrial commodities for which the Soviet Union has been dependent on foreign countries is rubber. During the past three years this need has been largely filled by the production of synthetic rubber, in three large plants, at Yaroslavl, Voronezh, and Efremov, the last beginning operations in May 1933.

The production of synthetic rubber is still far from being equal to the demand. It is therefore necessary to search for the cheapest and most abundant raw materials, such as potato or grain alcohol, or alcohol from sawdust, as recently made at Cherepovets, from which ethylene can be obtained. Another source is ethylene now a waste product. If the coke oven gases were recovered, up to 100,000 tons of ethylene would be obtained, and the same quantity from petroleum cracking plants. The Moscow "Neftegaz" plant alone discharges enough ethylene gas in a year to make 15,000 tons of synthetic rubber.

Future production of ethylene if recovered from the coke-chemical plants and the petroleum distilling plants when completed in 1937 would amount to 450,000 metric tons, out of which could be produced 80,000 tons of synthetic rubber, 80,000 tons of solvents for nitrocellulose lacquers, and 80,000 tons of benzol and toluol. The "Neftegaz" waste gases could be utilized now and an experimental plant is under construction in Moscow that will make rubber out of waste gas from local petroleum plants. Not only ethylene and synthetic rubber but also a long list of other valuable chemicals can be produced, which will govern the operation of a number of other lines of chemical plants; the motion picture industry can obtain ether, other industries that need it ethyl-acetate, etc.

At the present time 790 engineers and chemists, all young, are engaged in research in connection with synthetic rubber. Only 2 per cent graduated from technical institutes before 1931, the rest all in or since that year.

Chemical Equipment Code Finally Approved

Chemical Engineering Equipment Institute had its code officially approved by NRA on July 5. This follows the action reported in *Chem. & Met.* last month when on May 28 the definition of the chemical engineering equipment industry was adopted as a subdivision of the basic code of the Machinery and Allied Products Industry. According to Article VI of the approved code all employers of labor who fall within the provisions of this definition (see *Chem. & Met.*, p. 327, June, 1934) are required to register with the Code Authority and failing to do so, the Chemical Engineering Equipment Institute is not responsible for keeping non-member firms informed of the code's provisions.

The new code authority has not yet been consummated but will include in addition to an administration member, not more than two representatives of non-member companies and not more than twelve members of the board of directors of the Chemical Engineering Equipment Institute. Representatives of this group expected to serve on the industry's code authority include its president, John V. N. Dorr, president of the Dorr Company, Inc.; its vice-president, Henry D. Miles, president of the Buffalo Foundry and Machine Co.; the chairman of the code committee, James E. Moul, general manager of the Turbo-Mixer Corp.; C. L. Campbell, vice-president, E. B. Badger and Sons; Wm. E. Hall, president of the Duriron Co., Inc.; P. C. Kingsbury, chief engineer for General Ceramics Co.; H. E. LaBour, president, the LaBour Co.; S. F. Spangler, vice-president of the Chemical Construction Corp.; D. W. Sowers, president of Sowers Manufacturing Co., and Arthur Wright, proprietor of Arthur Wright and Associates.

Insecticide Code Authority Members Approved

National Recovery Administrator Hugh S. Johnson has announced his approval of the following personnel of the Code Authority for the agricultural insecticide and fungicide industry: R. E. Denmon, Stauffer Chemical Co., New York; G. F. Leonard, Tobacco By-Products & Chemical Corp., Louisville; C. M. Slaughter, J. Schnarr & Co., Orlando, Fla.; R. K. Vickery, California Spray Chemical Corp., Berkeley, Calif.; G. R. Rinke, John Powell & Co., New York; J. B. Cary, Niagara Sprayer & Chemical Corp., Middleport, N. Y.; R. N. Chipman, Bound Brook, N. J.; D. E. Connolly, Ansbacher-Seigle Corp., New York; G. E. Riches, Bowker Chemical Co., New York; and H. P. Mansfield, Grasselli Chemical Co., Cleveland.

The Administrator's approval of the above-named Code Authority is contingent upon his later determination of the status, in this industry, of the pyrethrum-rotonone group of manufacturers. In the event this group is to be excluded from the agricultural insecticide and fungicide code, Mr. Rinke automatically will cease to be a member of the Code Authority as a representative of the group. Should the pyrethrum-rotonone manufacturers be continued under this code, a general meeting of the members of that group will be called for the purpose of electing a member of the Code Authority.

Thirtieth Anniversary of Dorr Classifier

On Tuesday evening, July 17, the Senior engineering staff of the Dorr Company, Inc. tendered a dinner at the Long Shore Country Club, Westport, Conn., to John Van Nostrand Dorr to commemorate the thirtieth anniversary of his first invention, the Dorr classifier, which took place at the Lundberg, Dorr and Wilson gold mill in the Black Hills of South Dakota. Many of Mr. Dorr's friends of long standing attended, men who were associated with him in the early days of the West and who have seen the organization grow from one man and an office boy in Denver, Colorado, to the company of today with six offices in the United States, four associated companies in Europe and representatives in South Africa, Australia and Japan.

The commemoration of Mr. Dorr's first invention centered around a recounting of the old days in the West and the significant train of events which led to the invention of the classifier in 1904, the thickener in 1906, countercurrent decantation in 1910 and the agitator in 1912, all of which paved the way for the Company's growth during the last thirty years.

The principal speaker at the dinner was Dr. H. C. Parmelee, vice-president of the McGraw Hill Publishing Co., former editor of *Chemical & Metallurgical Engineering* and present editorial director of *Engineering and Mining Journal*. Dr. Parmelee commented on metallurgical practices in 1904 as contrasted with those of today and the relation they bear to chemical engineering.

CALENDAR

Technical Association of the Pulp and Paper Industry, fall meeting, Portland, Ore., Sept. 10-13.

American Chemical Society, fall meeting, Cleveland, Sept. 10-14.

Electrochemical Society, fall meeting, New York, Sept. 27-29.

Paint, Varnish and Lacquer Association, annual meeting, Washington, D. C., Oct. 31 to Nov. 3.

American Institute of Chemical Engineers, fall meeting, Pittsburgh, November, 1934.

Names in the News

S. H. Hammond, John H. Whiting and Gen. T. S. Hammond

John Hill Whiting, the founder and chairman of the board; Gen. T. S. Hammond, president and general manager; and S. H. Hammond (grandson of the founder), assistant to the president, are the three generations in active management of the Whiting Corp. of which they are celebrating the 50th anniversary. Mr. Whiting started business in Detroit but when the World's Fair in 1893 brought Chicago into prominence as the business center of the Middle West, he built a small portion of the present plant at Harvey, Ill.

Alfred L. Loebenberg has been named an executive of the Barrett Co. to act in the capacity of vice-president and assistant to the president. Mr. Loebenberg was formerly vice-president of the U. S. Industrial Chemical Co., which position he resigned to assume his new office.

Victor Dorkovich, who until recently was with the National Survey of Product Capacity, is now in England in connection with development of low temperature carbonization.

C. J. Goodwin, *Chem. & Met.* correspondent in London, is in New York for a visit. He resides at the Chemists' Club and has opened offices at 501 Fifth Ave.

W. F. Wurster has joined De Bothezat Corp.

William T. White, a graduate of Alabama Polytechnic Institute, formerly employed by the American Cyanamid and Combustion Utilities as a research chemist is now located in the same capacity with the Tennessee Valley Authority in the Synthetic Phosphate Division.

John Maxwell has been elected president and Edwin Cox vice-president of the Phosphate Products Corp., Richmond, Va. S. D. Crenshaw has become chairman of the board of the company.

A. Lynn Ivey, formerly vice-president, has been elected president of Virginia-Carolina Chemical Corp., succeeding George A. Holderness who recently retired from this post. Other recently elected officers are Spencer L. Carter, first vice-president in charge of operations, and M. S. Purvis, vice-president in charge of sales.

J. G. Lipman, for many years dean of the New Jersey College of Agriculture and director of the New Jersey Experiment Station, went on leave of absence for a year beginning July 1. During his absence, Dr. William H. Martin will be acting director of the station.

R. B. Stringfield will have charge of the new courses of study in rubber technology and synthetic resins in the chemical engineering department of the University of Southern California. Mr. Stringfield is secretary and manager of the Dental Plastics Co., Los Angeles. He was formerly chief chemist of the Goodyear Tire & Rubber Co. of California.

Ralph E. Flanders of Springfield, Vt., has been nominated for the presidency of the American Society of Mechanical Engineers.

C. E. Kinney, for many years technical service manager of the Naval Stores Department of Hercules Powder Co., has been assigned to handle special problems for the department.

J. M. Schantz, formerly assistant to Mr. Kinney, has been made manager of Naval Stores Technical Service.

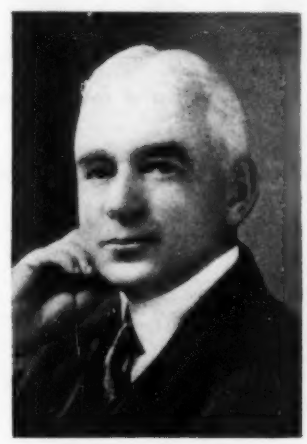
Francis Lamb of the department of physical chemistry at Michigan State College has joined the Michigan Smelting & Refining plant of the Bohn Aluminum & Brass Corp.

L. C. Hughes, consulting chemical engineer who has been in South America for almost a year in connection with his consulting work, has returned to his home in Elizabeth, N. J. He will continue to give attention to problems of the alkali, salt and heavy chemical industries.

Henry C. Parker, recently with K. P. McElroy, has announced the opening of an office at the National Press Building, Washington, where he will handle patent and trademark cases.

OBITUARY

Mme. Marie Curie, whose work alone and with her husband on radium and radiogy has contributed much to the welfare of mankind, died July 4 in a sanitarium near Sallandres in Upper Savoy. Her death, which was caused by a form of pernicious anemia, was hastened by what her physicians termed a long accumulation of radiations which affected the bones and prevented her from reacting normally to the disease.



W. H. Walker

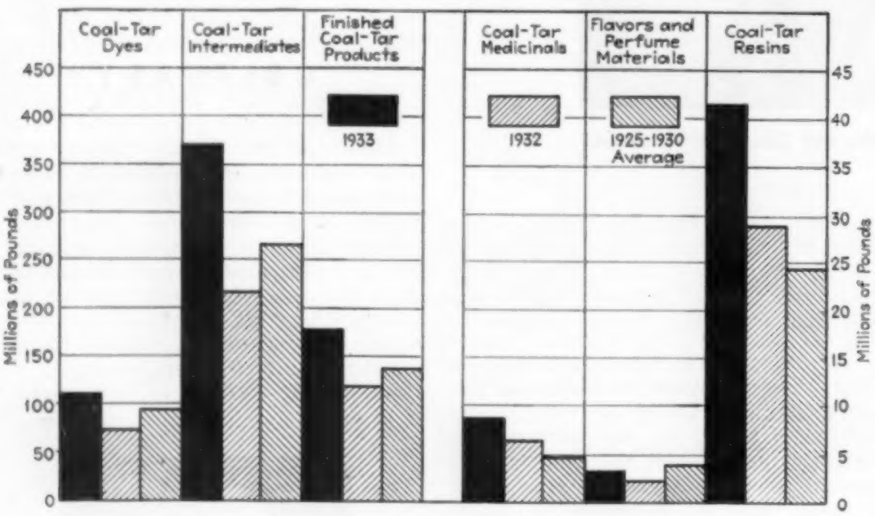
Col. William H. Walker was fatally injured at Seabrook, N. H., on July 9 when he apparently fell into a doze at the wheel of his car, which careened off the road against a tree. Dr. Walker was one of the most distinguished chemical engineers in the country and a pioneer leader in chemical engineering education. For many years he taught chemical engineering at M. I. T. and during the War served as commanding officer of Edgewood Arsenal.

Domestic Production of Coal-Tar Dyes Increased in 1933

Of outstanding interest in the report on production and sales of dyes and other synthetic organic chemicals in 1933, as compiled by the U. S. Tariff Commission, was the gain in output of dyes which was reported at 100,952,178 lb. or 7 per cent above the average for 1925-1930. Sales of dyes totaled 98,228,671 lb. valued at $43,095,630, or 6.5 per cent more in volume, and 9 per cent more in value than the 1925-1930 average, and exceeded 1932 by more than 30 per cent in quantity. Sales of unclassified and special dyes, included in this total, increased to 7,725,254 lb. valued at $7,787,901. In this group remarkable progress is shown in dyes for acetate silk, oil and gasoline, and rubber and resins. Many new direct, developed, and vat dyes were reported, as well as increased production of the Zambesi blacks. Increased demand for dyes by the textile industry accounts for a large part of the increase in sales.

Outstanding among the coal-tar intermediates in 1933 as compared with 1932 are increased production of aniline oil 52 per cent, refined naphthalene 65 per cent, phenol 138 per cent, and phthalic anhydride 125 per cent. These increases are due mainly to the increased demand for the synthetic resins derived from these materials. Total production of intermediates was 370,708,000 lb. or 4.6 per cent more than the peak year of 1929.

Remarkable increases are noted for synthetic resins derived from phenol and cresol. Sales quantity increased 61 per cent over 1930 and 86 per cent over 1932, while unit values declined from $0.38 per lb. in 1930 to $0.23 in 1933. Separate data for resins derived from phthalic anhydride are published for the first time. Sales of synthetic resins



Production of coal-tar products compared to 1925-1930 average

Production and sales of dyes and other synthetic organic chemicals, 1925-30, 1932 and 1933

	1925-30 average 1,000 Lb.	1932 1,000 Lb.	1933 1,000 Lb.
Intermediates:			
Production	267,492	218,143	370,708
Sales	109,133	96,960	163,672
Finished coal-tar products:[1]			
Production	138,078	118,702	[2]175,914
Sales	133,964	114,980	[2]161,837
Dyes:			
Production	94,003	71,269	100,953
Sales	92,207	73,591	98,229
Medicinals:			
Production	4,508	6,365	8,715
Sales	4,106	6,090	8,070
Flavors and perfume materials:			
Production	3,966	2,307	3,159
Sales	3,919	2,250	2,965
Coal-tar resins:			
Production	24,442	29,039	[2]41,628
Sales	22,135	23,891	[2]31,658
Synthetic non-coal-tar chemicals:			
Production	379,972	No	767,574
Sales	264,006	data	538,990
Non-coal-tar resins:			
Production	No	1,898	3,572
Sales	data	1,787	3,256

[1]Includes color lakes, photographic chemicals and miscellaneous coal-tar products not shown separately.
[2]Does not include some resins.

Production and sales of certain synthetic organic chemicals of non-coal-tar origin, 1933

	Total production, Lb.	Sales: Quantity Lb.	Sales: Value	Sales: Unit value
Total	767,574,117	538,990,467	$52,401,327	$0.097
Acetaldehyde	40,795,528	....	....	.....
Acetic anhydride	57,885,123	8,466,135	1,204,377	.142
Acetone	....	42,205,443	3,047,923	.072
Amyl acetate and sec amyl acetate	4,516,564	8,075,080	815,882	.101
Anethol	11,776	7,067	5,406	.765
Butyl acetate (n and sec)	32,608,424	27,717,540	2,483,022	.090
Butyl alcohol (n, sec, and tertiary) (butanol)	39,734,513	27,492,432	2,235,761	.081
Carbon tetrachloride	35,707,211	31,139,594	1,352,694	.043
Chloroform, tech and USP	2,128,767	1,476,020	236,299	.160
Citral	22,177	20,937	34,204	1.63
Ethyl acetate (85 per cent)	41,121,394	25,234,242	1,739,918	.069
Ethyl butyrate	46,023	....	....	.....
Ethyl ether, tech, USP and absolute	7,494,705	5,286,846	1,146,432	.217
Ethyl nitrite	19,271	19,103	11,680	.611
Ethyl isovalerate	....	494	813	1.65
Formaldehyde (40 per cent)	52,236,203	46,423,621	1,751,358	.038
Gallic acid, tech	265,402	....	....	.....
Geraniol	196,415	157,407	257,686	1.64
Heliotropin	15,894	13,182	22,980	1.74
Ionone	29,322	28,009	86,610	3.09
Isoamyl acetate	17,291	17,830	5,437	.305
Isoamyl butyrate	11,698	8,955	7,052	.791
Isoamyl formate	....	202	201	.995
Methanol, synthetic	66,099,718	74,814,686	3,297,060	.044
Oxalic acid	8,843,057	8,977,003	897,653	.100
Pyrogallol (pyrogallic acid)	74,044	71,251	93,167	1.31
Rhodinol	3,486	3,279	42,610	12.99
Synthetic Medicinals of Non-Coal-Tar Origin, 1933				
Total	421,734	427,561	1,083,540	2.58
Barbituric acid derivatives	78,645	69,018	555,757	8.05
Glycocol (aminoacetic acid) (glycine)	3,224	3,386	16,561	4.89
Synthetic Resins of Non-Coal-Tar Origin				
Total	3,571,717	3,256,411	1,745,102	.536
Derived from urea or thiourea	3,234,356	2,977,791	1,422,671	.478
All other	337,361	280,620	322,431	1.15

Coal-tar crudes:[1] Production and sales, 1933

		Production	Sales
Tar	gal.	[3]363,298,586	241,000,100
Light oil and derivatives:			
Crude light oil	gal.	103,023,997	7,843,234
Benzol (except motor benzol)	gal.	19,382,352	19,722,822
Motor benzol	gal.	40,224,022	38,654,902
Toluol, crude and refined	gal.	[3]11,539,107	11,541,990
Solvent naphtha	gal.	[2]2,717,254	2,570,981
Xylol	gal.	[2]2,101,377	2,271,658
Other light oil products	gal.	5,329,997	2,445,350
Naphthalene, crude and refined	lb.	[4]30,620,754	25,252,619
Crude tar acids	gal.	2,858,513	724,740
Creosote oil	gal.	57,436,545	58,030,083
Tars, refined	gal.	[2]6,902,851	6,550,278
Tars, road	gal.	[3]95,613,206	99,062,021
Other distillates	gal.	[2]6,785,571	6,763,174
Pitch of tar	tons	588,728	323,065
Pitch of tar coke	tons	[2]27,828	33,082

[1]Data for coke ovens and gas works reporting to Bureau of Mines; and for tar refineries and others reporting to United States Tariff Commission.
[2]Reported to United States Tariff Commission only.
[3]Reported to Bureau of Mines only.
[4]Includes crude and refined naphthalene reported to Bureau of Mines and crude naphthalene reported to United States Tariff Commission.

not of coal-tar origin increased 82 per cent in quantity and 119 per cent in value over the preceding year. Separate data for urea and thiourea resins are also shown for the first time. At least part of the increased activity in synthetic resins was due to demand for closures for beverage bottles, and for containers of cosmetics, toilet preparations, and food.

Activities in synthetic organic chemicals not of coal-tar origin reached an all-time peak in 1933 with a production of 767,574,117 lb. and sales totaling 538,990,467 lb. valued at $52,401,327. Production increased 26 per cent, and sales volume 23 per cent over 1930, while sales value decreased 20 per cent. Outstanding in this field are the synthetic alcohols (ethyl, butyl, and methyl), formaldehyde, carbon tetrachloride acetic anhydride, acetone, and others.

New Consuming Demands Reduce Supplies of Glycerin

GLYCERIN stocks are short and prices are advancing. A dozen or more explanations are offered in the market. The truth appears to be that no single factor has produced this result but an unusual combination of new demands, both domestic and export, has given the effect noted.

Japanese government's purchases of glycerin are said to have been much more than usual in the last 6 to 10 months. Unfortunately export statistics on glycerin are no longer separately maintained by the Government. A quantitative appraisal of this factor is, therefore, not possible. But it is estimated that this factor does not account for more than a few million pounds of unusual demand. Domestic requirements probably account for greater increases in consumption, hence greater depletion of stocks.

Last year there was an unusually large production of Glyptal resins. Nearly 10 million pounds of products apparently consumed several million pounds more glycerin than ever was used before in this direction. Estergums manufacture accounts for other slight increases in consumption. The glycerin industry had a good anti-freeze season last winter. Several other uses either became important for the first time or increased definitely. In effect, therefore, the domestic consumption increased relative to domestic supply enough to deplete the stocks and occasion price increases from about 10 cents a pound quoted late last year to 15 cents a pound currently quoted.

Further increases in consumption are expected. And a secondary decline in production would not be surprising in view of the changed soap-fat situation. Use of inedible tallow and other domestic fats as a substitute for imported coconut oil is sure to be attempted by the soap makers in order to offset the increased cost of the imported oil incident to the excise tax placed by the late unlamented Congress. For each unit of fatty acid made, the quantity of glycerin recovered will be less following such substitution. This is inevitable because cottonseed oil gives a higher glycerin yield than the other commercial soap fats. Hence even with a constant soap business reduced glycerin supplies are expected. Some forecast a further distinct price rise as a consequence.

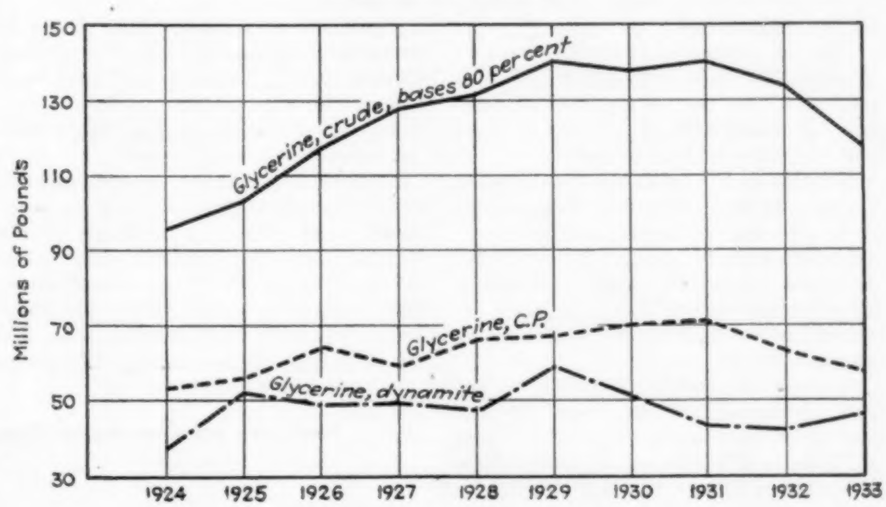
Imports of glycerin may be increased, at a price. Substitution for glycerin will undoubtedly care even more effectively for the situation. The various glycols are, of course, the principal synthetic chemicals offered as substitutes. Ethylene glycol is admirable for this purpose in the case of nitroglycerin manufacture, automotive anti-freeze, and diethylene glycol for tobacco manufacture. Hence for the three principal industrial uses of refined glycerin, there are readily at hand these synthetic substitutes which can be supplied in unlimited quantities independent of any byproduct feature. This means that a ceiling price exists preventing any chance for a runaway market.

Crude production and crude imports of glycerin are used mainly as the raw material for making the domestically produced refined grades, "dynamite grade" and "chemically pure." Hence the supplies of refined glycerin actually available for consumption are only the total of dynamite grade, chemically pure, and imported refined. In other words, the domestic supply in recent years has been approximately 110 to 120 million pounds per year. Imports, it will be noted, constitute only a small part of the total supply in recent years.

Imports of Glycerin

	Crude Lb.	Refined Lb.
1924	13,600,000	1,500,000
1925	18,600,000	2,000,000
1926	27,563,962	10,880,454
1927	14,784,615	8,268,071
1928	4,915,651	4,210,467
1929	14,601,736	5,493,471
1930	10,906,426	3,177,479
1931	9,951,473	1,975,970
1932	5,184,411	2,333,606
1933	6,204,636	2,777,918

Production of Glycerin



Distillery to Use Waste Treatment System

Industrial waste treatment devices, costing approximately $300,000 are to be installed by Hiram Walker & Sons, Inc., at its Peoria, Ill., distillery. The expenditure is to be made for evaporators and additional dryers, and housing. The plant, with a rated capacity of 20,000 bushels per day, is to operate on half-capacity output schedule until the treatment plant is in operation.

The company agreed to install the treatment devices after the State Sanitary Water Board had denied its application to discharge untreated waste —which, it is estimated, would approximate that from a city of one million inhabitants—into the Illinois River.

January 1, 1935, is the date set by the board as that on which the complete screening, evaporating and drying equipment must be in operation. Contract for the evaporating equipment must be let not later than Sept. 1, 1934.

CHEMICAL ECONOMICS

Outputs of chemicals have shown some contraction in the last few weeks. Some important branches still cling to a standard rate of manufacture but this is not general and the tendency for the industry as a whole has been to check the rate of operation more in accord with the position of consuming industries.

A NEW peak in the recovery program since the speculative boom last August has been reported by the Federal Reserve Board in its monthly survey of business.

Figures compiled by the board showed that industrial activity in May reached 87 per cent of the 1923-25 average, compared with 86 per cent in April and 72 per cent in November.

Activity in May was slightly ahead of a year ago and compared with activity of 91 per cent in August, 1933.

Rather higher activity in steel mills, increased construction and improvement in petroleum during May, the board reported, more than offset decreases in automobiles and textiles.

Activity at steel mills, the board said, increased further from 54 per cent of capacity in April to 58 per cent in May, while output of automobiles showed a decline. Lumber production continued at about one-third of the 1923-25 level. In the textile industries output declined somewhat. At mines, coal production showed little change. Output of petroleum continued to increase.

In the first three weeks of June activity at steel mills continued at about the May level, although a decline is usual at this season. Maintenance of activity reflected in part, according to trade reports, considerable stocking of steel.

Employment in factories, which usually declines slightly between the middle of April and the middle of May, showed little change, while employment on the railroads, in agriculture as well as in the construction industry, showed increases.

Increased employment was shown at manufacturing establishments producing durable goods, such as iron and steel and nonferrous metals, while employment declined at establishments producing non-durable manufactures.

Shipments of rayon yarns surprisingly showed a gain in June as compared with May, according to the *Textile Organon*, monthly publication of the Tubize Chatillon Corporation. The index figure covering June shipments was 299 as compared with 273 for May and 289 for April. The average for the six months ended June was 336, compared with a monthly average of 385 for the full year 1933.

Regarding the rayon market the paper states that it was "quite active around mid-June, but toward the end of the month the dull period resumed. This mid-June consumption spurt, plus the fewer number of working days in June, caused the increase in the unadjusted deliveries index. Also there was possibly some buying of rayon for future use, in view of the restricted booking period used by the producers, which, in turn, indicated that the current low price of yarn is a temporary one only."

The paper estimated that mid-year stocks of rayon yarn held by producers was not more than five weeks' supply, as compared with eight to ten weeks' supply held at similar periods in the past.

While the publication calls attention to the favorable trend of cotton consumption during June, it adds that "it is believed that cotton consumption will tend downward for the June to August reports." In reference to wool, it expresses the opinion that "we regard the present wool market as unstable, inasmuch as the factors of supply, demand, and price are out of balance."

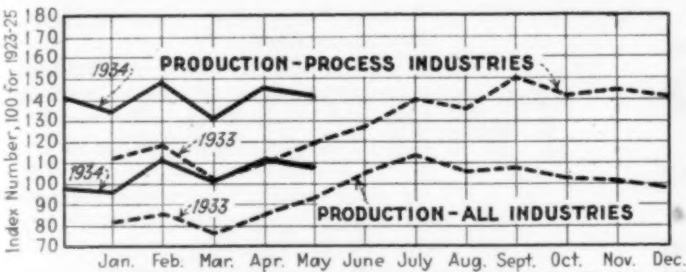
Commenting upon the consumption of the various fibers for the first half of 1934, the *Organon* states that "the fact that the first half of this year is the worst half-year of the current two-year cycle of textile consumption makes the comparison for the first half of 1934 not only timely, but hopeful. We expect the last half of 1934 will make a much better showing than the first half of this year."

Paints, glass, ceramics, and metallurgical trades are considerably below their high point for the year. This is a seasonal condition and does not destroy the confidence that generally is expressed for an active revival in general business during the latter months of the present year.

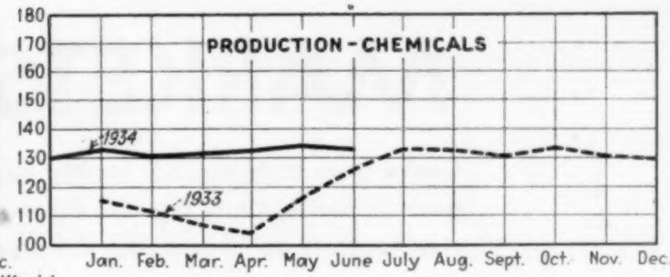
Production and Consumption Data for Chemical-Consuming Industries

Production	May 1934	May 1933	Jan.-May 1934	Jan.-May 1933	Per Cent of Gain Jan.-May 1934
Automobiles, No.	331,641	214,832	1,406,263	743,287	89.2
Byproduct Coke, 1,000 tons	3,192	1,921	14,005	8,667	61.6
Cellulose-Acetate Plastics, Sheets, Rods, Tubes, 1,000 Lb.	512	235	2,221	813	173.2
Nitro-cellulose Plastics, Sheets, Rods, Tubes, 1,000 Lb.	973	982	5,892	3,300	78.5
Glass Containers, 1,000 Gr	3,252	1,693	14,574	8,186	78.0
Plate Glass, 1,000 Sq. Ft	7,764	7,922	41,368	28,628	44.5
Cottonseed Oil, Crude, 1,000 Lb	38,676	72,773	491,575	542,881	9.5*
Cottonseed Oil, Refined, 1,000 Lb	63,892	108,169	520,461	540,337	3.7*
Pyroxylin Spread, 1,000 Lb.	3,350	3,920	21,791	13,642	59.8
Steel Barrels, No.	494,051	531,304	3,128,472	2,063,445	51.6
Sulphuric Acid Produced in Fertilizer Trade, Tons	107,568	90,605	643,162	458,276	40.3
Rosin, Wood, Bbl.	43,243	31,045	228,413	139,339	63.9
Turpentine, Wood, Bbl.	7,050	5,028	37,920	22,264	70.3
Rubber Reclaimed, Tons	10,948	7,864	49,995	25,107	99.1
Pneumatic Automobile Tires, 1,000	4,309	4,151	21,969	11,957	83.8
Consumption					
Cotton, 1,000 Bales	520	621	2,563	2,497	2.6
Silk, Bales	38,740	47,151	200,175	206,864	3.4*
Paint, Varnish, and Lacquer, Sales, $1,000	33,679	26,241	123,000	81,805	50.4
Sulphuric Acid and Fertilizer Trade, Tons	83,969	67,162	636,530	404,900	57.2

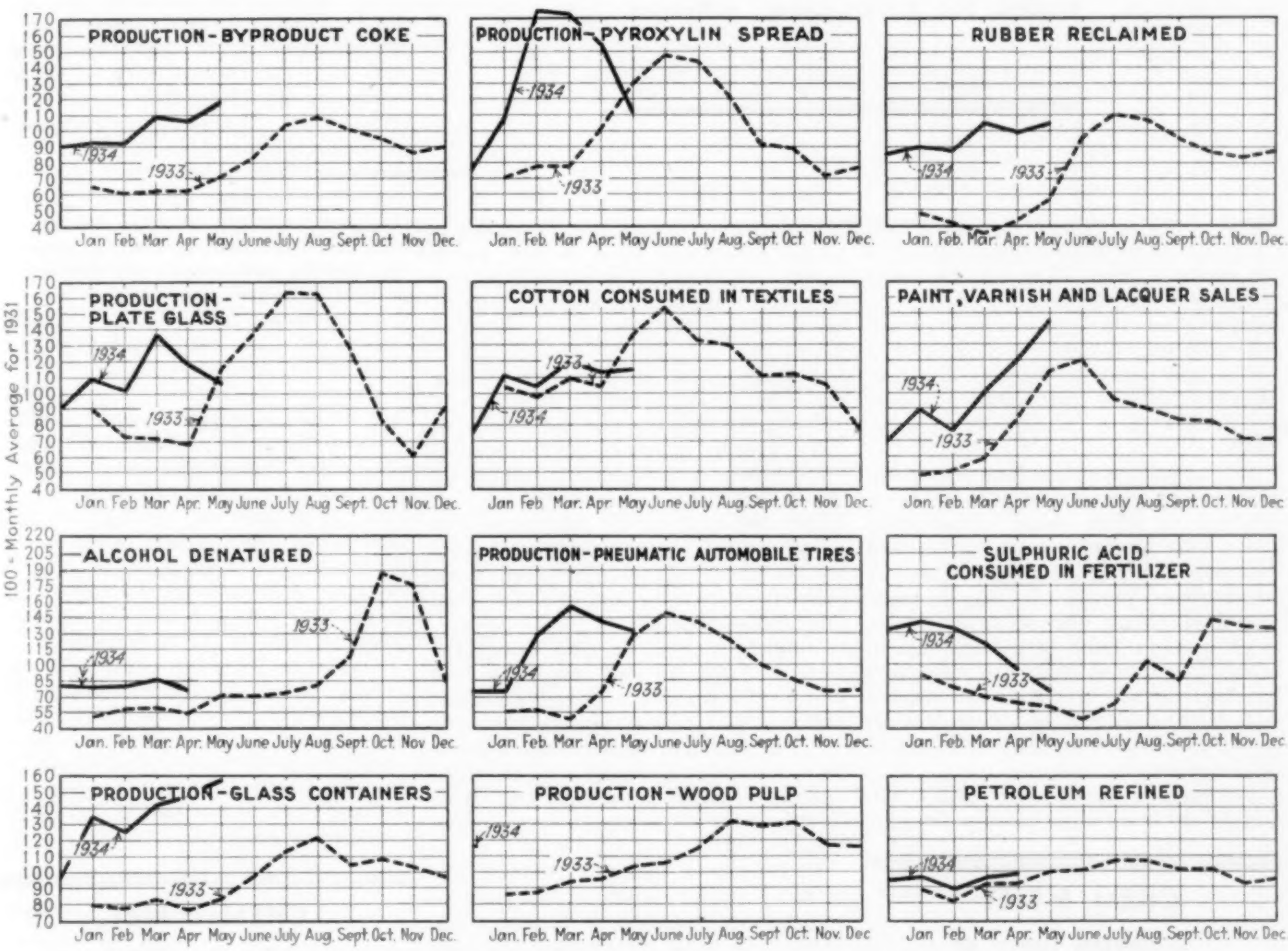
* Per cent of Decline.

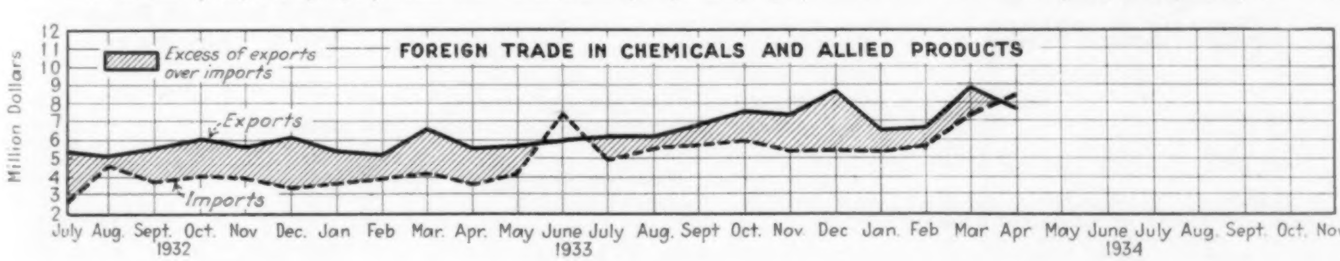


Based on electrical power consumption, data supplied by Electrical World



TRENDS OF PRODUCTION AND CONSUMPTION





MARKETS

Conferences held abroad, for the purpose of having Chile join the international nitrate agreement, did not meet with success but further work in that direction may be expected. Naval stores industry works to revise present standards and cut down the number of grades. Contract prices for chemicals have generally been extended for third-quarter deliveries.

TRADING in chemicals and related products is proceeding along rather routine lines. Most of the more important chemicals are offered on contracts for third-quarter delivery at the same prices that prevailed through the second quarter. Spot trading has been described as spotty, with the general result of a falling off in sales volume.

It generally follows that a slowing up in buying interest is followed by a tendency to soften prices. This situation exists in the present market and different materials have been offered at concessions. Potash salts may be mentioned as among the materials where price changes have been decidedly in favor of the buyer. Foreign competition has been active in the potash market and price weakness has been due to selling pressure rather than to a decline in consuming demand.

During the last month prices for acetate of lime were sharply lowered and the sales schedule for all grades of acetic acid were soon revised downward. This held true of acid makers in general and was not confined to those who make acetic acid from acetate of lime.

Foreign trade in chemicals is featured by a gain in export shipments of sulphur. During the first five months of 1934, exports of crude sulphur totalled 192,129 tons, valued at \$3,575,200, compared with 136,512 tons, valued at \$2,601,200, in 1933, a value increase of 37 per cent. Refined sulphur exports during these periods increased from 2,966 to 4,164 tons and in value from \$109,160 to \$165,170.

Sulphur exports in 1933 were very widely distributed but the most important markets were Canada, France, Germany, Australia, The Netherlands, and New Zealand, named in the order of their importance. Exports to all these countries except Australia and New Zealand were larger in the current year than in 1933.

In the nitrate industry, attention has centered in the series of conferences which have been held in Europe. The purpose of these conferences was said to be to try and bring Chile into the international nitrate agreement. The terms offered to Chile, however, are said to have been rejected and the conferences closed without having gained their objective.

The agreement between the European synthetic manufacturers in the C. I. A. group, arranged two years ago, was recently extended to June 30, 1935, without modification and by unanimous consent. Included are the synthetic nitrogen interests of Germany, Great Britain, France, Italy, Holland, Norway and Switzerland.

In view of the situation in potash salts where competition of late has been very keen and where prices now are withdrawn, added interest attaches to a report from Germany which states that for some months important negotiations have been in progress between the leading German potash producer, Wintershall, (controlling around 50 per cent of Germany's potash output) and the Burbach Company, with a view to the former concern, one of Germany's strongest and most successful industrial concerns, extending financial aid for placing its competitor in sound condition. Although arrangements have not been definitely consummated, it has been proposed by Wintershall that the Burbach capital be further written down, or to 12,000,000 from 20,000,000 marks, and then be increased to 18,000,000 marks by 6,000,000 marks furnished by Wintershall. However, this adjustment is conditional upon the interest rate on Burbach's large bonded indebtedness being reduced to 4 per cent (from an average of 6.3 per cent in 1933 and 8.6 per cent in 1932) and, moreover, payment against the principal of the debt being waived for a period of years.

Amendments to the license for processors of gum turpentine and gum rosin were approved on June 27, by Secretary of Agriculture Henry A. Wallace, to become effective June 28. Under this license, as amended, no licensee shall either ship or market any package of cleaned gum, gum turpentine or gum rosin, or process any package of crude gum except into cleaned gum, gum turpentine or gum rosin for marketing or shipping as such, unless an appropriate tag or tags issued by the control committee be attached to the package.

The price trend for rosin and turpentine has been downward and the unsatisfactory position of the industry has brought out vigorous protests against some of existing regulations. On June 29 a preliminary hearing was held in New York to discuss changes in the U. S. rosin standards.

CHEM. & MET.
Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	87.79
Last month	88.35
July, 1933	86.01
July, 1932	84.33

Reductions in prices for acetic acid and spirits of turpentine were largely responsible for the drop in the weighted index number for chemicals. Lead oxides also were lower but chemicals with these exceptions showed very little change.

CHEM. & MET.
Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	60.54
Last month	57.48
July, 1933	61.44
July, 1932	41.95

The price in the market for oils and fats was decidedly upward in the last month. Most of the selections were held at higher prices and the rising tendency is expected to continue. Linseed oil was an exception to the general rule.

CURRENT PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to July 14.

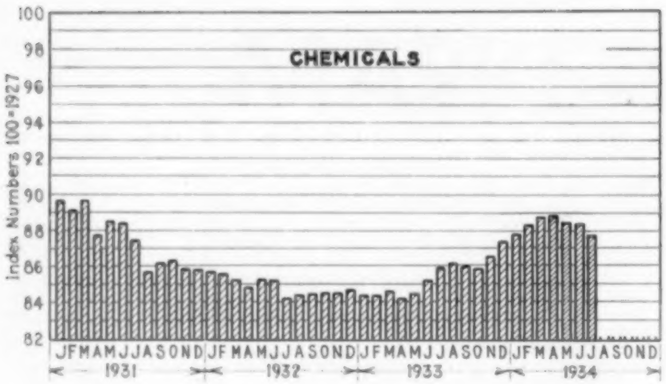
Industrial Chemicals

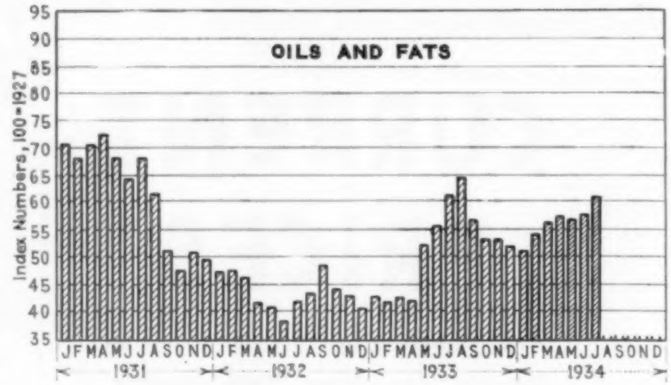
	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.11 -$0.11½	$0.11 -$0.11½	$ .08½-$0.09
Acid, acetic, 28%, bbl., cwt	2.76 - 2.90	2.90 - 3.15	2.90 - 3.15
Glacial 99%, drums	10.02 -10.27	10.02 -10.27	10.02 -10.27
U. S. P. reagent, c'bys	10.52 -10.77	10.52 -10.77	10.52 -10.77
Boric, bbl., lb	.04¾- .05	.04¾- .05	.04¾- .05
Citric, kegs, lb	.28 - .31	.28 - .31	.29 - .31
Formic, bbl., lb	.11 - .11½	.11 - .11½	.10 - .11
Gallic, tech., bbl., lb	.60 - .65	.60 - .65	.55 - .60
Hydrofluoric 30% carb., lb	.07 - .07½	.07 - .07½	.06 - .07
Latic, 44%, tech., light, bbl., lb	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb	.06 - .06½	.05½- .06	.05½- .06
Muriatic, 18° tanks, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb	.11¾- .12¾	.11¾- .12¾	.11 - .12
Phosphoric, tech., c'bys., lb	.09 - .10	.09 - .10	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -......	15.50 -......	15.50 -......
Tannic, tech., bbl., lb	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb	.26 - .26½	.26 - .26½	.23 - .24
Tungstic, bbl., lb	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, Amyl	......-......	......-......	......-......
From Pentane, tanks, lb	.143-......	.143-......	.15 -......
Alcohol, Butyl, tanks, lb	.095-......	.095-......	.095-......
Alcohol, Ethyl, 190 p'f., bbl., gal	4.15½-......	4.15½-......	2.53½-......
Denatured, 190 proof			
No. 1 special, dr., gal	.346-......	.346-......	.34½-......
No. 5, 188 proof, dr., gal	.34 -......	.34 -......	.38½-......
Alum, ammonia, lump, bbl., lb	.03 - .04	.03 - .04	.03 - .04
Chrome, bbl., lb	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb	.03 - .04	.03 - .04	.03 - .04
Aluminum sulphate, com., bags cwt	1.... 1.50	1.35 - 1.50	1.25 - 1.40
Iron free, bg., cwt	1.90 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb	.15½- .16	.15½- .16	.15½- .15½
tanks, lb	.04½-......	.04½-......	.05 -......
Ammonium carbonate, powd. tech., casks, lb	.08 - .12	.08 - .12	.08 - .12
Sulphate, wks., cwt	1.25 -......	1.25 -......	1.125-......
Amylacetate tech., tanks, lb., gal	.142-......	.142-......	.135-......
Antimony Oxide, bbl., lb	.08½- .09	.08½- .09	.07½- .08
Arsenic, white, powd., bbl., lb	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb	.15 - .15½	.15 - .15½	.11½- .12
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton	74.00 -75.00	74.00 -75.00	63.00 -65.00
Nitrate, cask, lb	.08½- .09	.08½- .09	.07½- .07½
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt	1.85 - 2.00	1.85 - 2.00	1.75 - 2.00
Borax, grain, bags, ton	40.00 -45.00	40.00 -45.00	40.00 -45.00
Bromine, cs., lb	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	2.50 -......	3.00 -......	3.00 -......
Arsenate, dr., lb	.05 - .07	.05 - .07	.05½- .06½
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton	17.50 -......	17.50 -......	17.50 -......
flake, dr., wks., ton	19.50 -......	19.50 -......	19.50 -......
Phosphate, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb	.05½- .06	.05½- .06	.05 - .06
Tetrachloride drums, lb	.05½- .06	.05½- .06	.05½- .06
Chlorine, liquid, tanks, wks., lb	.0185-......	.0185-......	.01¾-......
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb	1.35 - 1.40	1.35 - 1.40	1.15 - 1.25

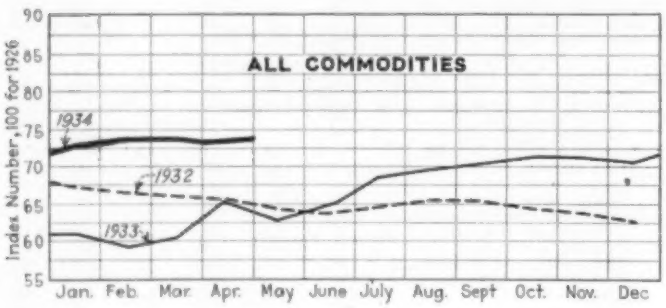
	Current Price	Last Month	Last Year
Copperas, bgs., f.o.b. wks., ton	14.00 -15.00	14.00 -15.00	14.00 -15.00
Copper carbonate, bbl., lb	.08½- .16	.08½- .16	.07 - .16
Cyanide, tech., bbl., lb	.39 - .44	.39 - .44	.39 - .44
Sulphate, bbl., cwt	3.85 - 4.00	3.85 - 4.00	3.75 - 4.00
Cream of tartar, bbl., lb	.19½- .20	.19½- .20	.15½- .16
Diethylene glycol, dr., lb	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt	2.10 - 2.15	2.10 - 2.15	1.70 - 2.00
Imp., tech., bags, cwt	2.00 - 2.10	2.00 - 2.10	1.15 - 1.25
Ethyl acetate, drums, lb	.08½-......	.08½-......	.08½-......
Formaldehyde, 40%, bbl., lb	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal	.75 -......	.75 -......	.75 -......
Refined, dr., gal	1.25 - 1.30	1.25 - 1.30	1.25 - 1.30
Glaubers salt, bags, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb	.13½- .14	.13½- .14	.10½- .10½
Lead:			
White, basic carbonate, dry casks, lb	.06½-......	.06½-......	.06½-......
White, basic sulphate, sck., lb	.06 -......	.06 -......	.06 -......
Red, dry, sck., lb	.06½-......	.06½-......	.07½-......
Lead acetate, white crys., bbl., lb	.10½- .11	.10½- .11	.10½- .11
Lead arsenate, powd., bbl., lb	.09 - .13	.09 - .13	.09 - .13
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk, lb	.05½-......	.05½-......	.07 -......
Lithophone, bags, lb	.04½- .05	.04½- .05	.04½- .05
Magnesium carb., tech., bags, lb	.06 - .06½	.06 - .06½	.05½- .06
Methanol, 95%, tanks, gal	.33 -......	.33 -......	.33 -......
97%, tanks, gal	.34 -......	.34 -......	.34 -......
Synthetic, tanks, gal	.35½-......	.35½-......	.35½-......
Nickel salt, double, bbl., lb	.11½- .12	.11½- .12	.12 - .12½
Orange mineral, csk., lb	.09½-......	.09½-......	.10½-......
Phosphorus, red, cases, lb	.45 - .46	.45 - .46	.42 - .44
Yellow, cases, lb	.28 - .32	.28 - .32	.28 - .32
Potassium bichromate, casks, lb	.07½- .08½	.07½- .08½	.07½- .08
Carbonate, 80-85%, calc. csk., lb	.07 - .07½	.07 - .07½	.05 - .06
Chlorate, powd., lb	.09½- .10	.09½- .10	.08 - .08½
Hydroxide (c'stic potash) dr., lb	.07½- .07½	.07½- .07½	.06½- .06½
Muriate, 80% bgs., ton	31.90 -......	31.90 -......	37.15 -......
Nitrate, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb	.18½- .19	.18½- .19	.16 - .16½
Prussiate, yellow, casks, lb	.18 - .19	.18 - .19	.16½- .17
Sal ammoniac, white, casks, lb	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt	1.00 - 1.05	1.00 - 1.05	.90 - .95
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt	1.23 -......	1.23 -......	1.20 -......
Dense, bags, cwt	1.25 -......	1.25 -......	1.22½-......
Soda, caustic, 76%, solid, drums, contract, cwt	2.60 - 3.00	2.60 - 3.00	2.50 - 2.75
Acetate, works, bbl., lb	.04½- .05	.04½- .05	.04½- .05
Bicarbonate, bbl., cwt	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb	.05½- .06½	.05½- .06½	.04½- .05
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb	.03 - .04	.03 - .04	.03½- .04
Chlorate, kegs, lb	.06½- .06½	.06½- .06½	.05½- .07½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb	.15½- .16	.15½- .16	.15½- .16
Fluoride, bbl., lb	.07½- .08	.07½- .08	.07 - .08
Hyposulphite, bbl., lb	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt	3.25 - 3.40	3.25 - 3.40	3.25 - 3.40
Nitrate, bags, cwt	1.35 -......	1.35 -......	1.345-......
Nitrite, casks, lb	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb	.021- .023	.021- .023	.02 - .023
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (40° dr.) wks. cwt	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60-62%, dr., lb	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, cyrs., bbl., lb	.02½- .02½	.02½- .02½	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr., lb	.03½- .04	.03½- .04	.03½- .04
Dioxide, cyl., lb	.07 - .07½	.07 - .07½	.06½- .07
Flour, bag, cwt	1.60 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin Oxide, bbl. lb	.56 -......	.56 -......	.47 -......
Crystals, bbl., lb	.38½-......	.39 -......	.35½-......
Zinc chloride, gran., bbl., lb	.05½- .06	.05½- .06	.06½- .06½
Carbonate, bbl., lb	.09½- .11	.09½- .11	.10½- .11
Cyanide, dr., lb	.38 - .42	.38 - .42	.38 - .42
Dust, bbl., lb	.07 - .07½	.07 - .07½	.06½- .07
Zinc oxide, lead free, bag, lb	.06½-......	.06½-......	.05½-......
5% lead sulphate, bags, lb	.06½-......	.06½-......	.05½-......
Sulphate, bbl., cwt	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

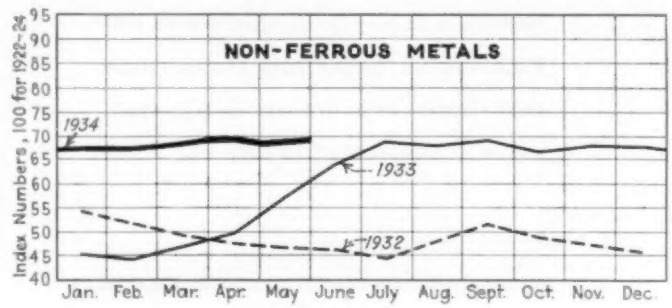
Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb	$0.09½-$0.10	$0.09½-$0.10	$0.08½-$0.09
Chinawood oil, bbl., lb	.09½-......	.09¾-......	.08¾-......
Coconut oil, Ceylon, tanks, N. Y. lb	.02¾-......	.02¾-......	.03½-......
Corn oil crude, tanks, (f.o.b. mill), lb	.05½-......	.04½-......	.06¼-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.04½-......	.04¼-......	.04¾-......
Linseed oil, raw car lots, bbl., lb	.097-......	.099-......	.109-......
Palm, Lagos, casks, lb	.03¼-......	.03¼-......	.04¼-......
Palm Kernel, bbl., lb	.03½-......	.03½-......	.04½-......
Peanut oil, crude, tanks (mill), lb	.05½-......	.05½-......	.06 -......
Rapeseed oil, refined, bbl., gal	.37 - .38	.38 - .40	.49 - .50
Soya bean, tank, lb	.06½-......	.06 -......	......-......
Sulphur (olive foots), bbl., lb	.07½-......	.07½-......	.05¾-......
Cod, Newfoundland, bbl., gal	nom.	nom.	.24 - .25
Menhaden, light pressed, bbl., lb	.051-......	.051-......	.051-......
Crude, tanks (f.o.b. factory), gal	.16 -......	.20 -......	.15 -......
Grease, yellow, loose, lb	.03½-......	.03½-......	.03½-......
Oleo stearine, lb	.05¾-......	.05¾-......	.05 -......
Red oil, distilled, d.p. bbl., lb	.07 -......	.07 -......	.06½-......
Tallow, extra, loose, lb	.03¾-......	.03½-......	.03¾-......









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb..	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb..	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.14½- .15
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Benzol, 90% tanks, works, gal..	.19 - .20	.19 - .20	.22 - .23
Beta-naphthol, tech., drums, lb..	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb.	.11 - .11½	.11 - .11½	.10½- .11
Cresylic acid, 97%, dr., wks., gal.	.50 - .51	.50 - .51	.42 - .45
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.	.06 - .07	.06 - .07	.04½- .05
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Phenol, U.S.P., drums, lb.	.14¼- .15	.14¼- .15	.14¼- .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal.	1.10 - 1.15	1.10 - 1.15	.90 - .95
Resorcinal, tech., kegs, lb.	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb.	.40 - .42	.40 - .42	.40 - .42
Solvent naphtha, w.w., tanks, gal.	.26 -......	.26 -......	.26 -......
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.30 -......	.30 -......	.30 -......
Xylene, com., tanks, gal.	.26 -......	.26 -......	.26 -......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton...	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.12½- .13	.12½- .13	.11¾- .13½
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb...	.04 - .20	.04 - .20	.02¾- .20
Prussian blue. bbl., lb.	.35½- .37	.35½- .37	.35 - .36
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.26 - .27	.26 - .27	.27 - .30
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	3.90 - 4.50
Para toner, lb.	.80 - .85	.80 - .85	.75 - .80
Vermilion, English, bbl., lb.	1.58 - 1.60	1.58 - 1.60	1.32 - 1.35
Chrome yellow, C. P., bbl., lb.	.15 - .16	.15 - .15½	.15 - .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb.	.09 - .10	.08 - .09	.06 - .08
Manila, bags, lb.	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.	.15½- .16	.15½- .16	.16 - .16½
Kauri No. 1 cases, lb.	.20 - .25	.20 - .25	.45 - .48
Kieselguhr (f.o.b. N.Y.), ton...	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton.	50.00 -......	50.00 -......	40.00 -......
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	5.35 -......	5.75 -......	5.50 -......
Turpentine, gal.	.47½-......	.52 -......	.53½-......
Shellac, orange, fine, bags, lb.	.35 -......	.37 -......	.20 - .21
Bleached, bonedry, bags, lb...	.32 - .33	.35 - .36	.22 - .23
T. N. bags, lb.	.26 - .27	.28 - .29	.12½- .13
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton..	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton..	13.75 -....	13.75 -.....	13.75 -.....

INDUSTRIAL NOTES

THE EDWARD VALVE & MFG. CO., East Chicago, Ind., announces the appointment of McGregor Engineering Co., Tulsa, Okla., as representative in Oklahoma, northern Arkansas and the Texas Panhandle.

HYDRO-ASH CORP. has moved to new quarters at 53 West Jackson Blvd., Chicago. The corporation has secured the manufacturing and sales rights in the United States for Leach Powdered Coal Burner.

ALLIS-CHALMERS MFG. CO., Milwaukee, announces the appointment of W. R. Judson as manager of the Salt Lake City district office, located in the Kearns Bldg. Mr. Judson succeeds H. E. Weiss, who has been transferred to the company's office at Kansas City.

THE UNITED STATES STONEWARE CO., Akron, Ohio, has received a manufacturing and selling license from the Hills-McCanna Co., to manufacture the Saunder Patent Diaphragm Valves with chemical stoneware bodies.

SOILADE, INC., a newly organized company for the manufacture of a new type of fertilizer, has begun operations in Miami, Fla. The plant and offices are located at 105 Northwest First street.

ENQUIST CHEMICAL CO., Brooklyn, N. Y., has moved into its new building at 255 Freeman St.

THE BARRETT CO., New York, has made Alfred L. Loebenberg, formerly vice-president of U. S. Industrial Alcohol Co., assistant to the president with title of vice-president.

STANDARD OIL CO., of Indiana has appointed Dr. O. E. Bransky, former manager of its refinery at Whiting, to the position of assistant general manager of manufacturing at Chicago. Dr. E. J. Shaeffer succeeds to the position of manager at Whiting.

COOLEY ELECTRIC FURNACE CO., Indianapolis, has secured the services of the Case Hardening Service Co. as its representative in the Cleveland territory.

REPUBLIC STEEL CORP., Youngstown, Ohio, has appointed the Pidgeon-Thomas Iron Co., Memphis, Tenn., as distributor of Enduro stainless steel in that territory.

THE SIVYER STEEL CASTING CO., Milwaukee, Wis., a producer of cast steel products, has announced the opening of a new New York office in charge of A. N. Diecks, at 500 Fifth Avenue. This office will specialize in the products of the oil refinery division of the company.

NEW CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Prices: Proposed Work and Bids	Current Prices: Contracts Awarded	Cumulative to Date: Proposed Work and Bids	Cumulative to Date: Contracts Awarded
New England........	$40,000	$2,100,000	$1,015,000	$1,120,000
Middle Atlantic......	722,000	28,000	3,321,000	2,394,000
Southern............	393,000	5,035,000	11,960,000	1,724,000
Middle West.........	5,238,000	....	8,020,000	1,823,000
West of Mississippi...	425,000	150,000	15,074,000	419,000
Far West............	1,140,000	....	2,802,000	938,000
Canada..............	752,000	375,000	3,118,000	....
Total.............	$8,710,000	$7,688,000	$45,310,000	$8,418,000

PROPOSED WORK

BIDS ASKED

Cellofilm Plant—Cellofilm Corp., Woodbridge, N. J., and 730 5th Ave., New York, N. Y., plans to alter and repair its plant at Woodbridge, N. J. Estimated cost $28,000.

Cosmetic Factory—Plough, Inc., c/o Abe Plough, 121 South 2nd St., Memphis, Tenn., plans the construction of a cosmetic and drug manufacturing factory. Estimated cost $40,000.

Cosmetic Factory—Plough, Inc., c/o A. Plough, 121 South 2nd St., Memphis, Tenn., plans to establish a factory in New York City, N. Y. Estimated cost $28,000 with equipment.

Chemical Equipment—Carolina Aniline & Extract Co., 1122 South Blvd., Charlotte, N. C., is in the market for the best type of equipment to be used in manufacturing textile chemicals and oils. G. S. McCarty, Pres. Estimated cost $25,000.

Chemical Plant—Globe Chemical Co., St. Bernard, O., is having plans prepared by H. Ballinger, Archt. and Engr., 3059 Feltz Ave., Cincinnati, O., for a plant. Estimated cost $90,000.

Chemical Plant—Hughes-Mitchell Process Co., Inc., Majestic Building, Denver, Colo., L. M. Hughes, Chairman of Board of Directors, has purchased an 18-acre site on Normandie Ave., near 190th St., Torrance, Calif., and plans to construct a chemical plant for the treatment of lead-zinc ores and reduction of various lead-zinc products therefrom. Company plans to handle 30,000 tons of ore at start of processing—ore to be obtained from California, Nevada, Idaho, Colorado, New Mexico and Arizona. Will use about 20,000 tons annually of salts produced at Trona, Calif., from deposits in Searles Lake. Estimated cost $1,000,000.

Chemical Plant—Carbide & Carbon Chemicals Corp., South Charleston, W. Va., is having plans prepared by R. N. Shepard, Chief Engr., c/o Owner, for a chemical plant, at Whiting, Ind. Estimated cost $5,000,000.

Cork Factory—The Korfund Co., 48-15 32 Pl., Long Island City, N. Y., plans to repair its plant recently damaged by fire. Estimated cost $28,000.

Distillery—Big Four Distilleries, controlled by United Distilleries of Canada, Ltd., H. H. Klein, Pres., Vancouver, B. C., is having plans prepared for a distillery at Dundalk, Md. Estimated cost $500,000.

Gas Plant—City Gas & Electric Corp., Ltd., Montreal, Que., Can., is preparing plans for the construction of a gas plant.

Gas Plant—City, Parsons, Kan., will hold election in August to vote on bonds for the construction of a gas plant. Estimated cost $275,000.

Laboratory—State Highway Comn., Trenton, N. J., will construct a laboratory building at Fernwood, N. J. C. N. Leathem, State Bldg., Trenton, is engineer. Estimated cost $80,000.

Paper Mill—Fort Miller Pulp & Paper Co., Schuylerville, N. Y., plans to repair its mill and install new equipment. Estimated cost $30,000.

Paper Mill—The Grays Harbor Pulp & Paper Co., Aberdeen, Wash., plans to construct a 50-ton digester annex at its mill to increase daily sulphite production of the pulp mill from 100 to 150 tons. Estimated cost $100,000.

Paper Mill—Hammermill Paper Co., Erie, Pa., plans the construction of a paper mill at Matane, Que., Can.

Paint Factory — O. Hommell Co., 211 4th Ave., Pittsburgh, Pa., plans the construction of a 1 story, 140x150 ft. factory at Pulaski (Lawrence Co.), Pa., for the manufacture of metallic paints.

Varnish Plant—Pontiac Varnish Co., Pontiac, Mich., is having plans prepared for an addition to its varnish plant on Brush St., to include a 1 story warehouse. Estimated cost $30,000.

Refinery—Champlain Oil Co., Pointe aux Trembles, Que., Can., will soon receive bids for the construction of a refinery on 23rd Avenue to have a daily capacity of 2,500 bbls. Estimated cost $350,000.

Petroleum Refinery—R. W. & Max Lewis, Ovid, Mich., plan the construction of a refinery at Elsie, Mich. Estimated cost $60,000.

Refinery—Pelican Refinery Co., Gladewater, Tex., is having preliminary surveys made for rebuilding its gasoline refinery. Estimated cost $150,000.

Refinery—Trinity Petroleum Co., Ltd., Calgary, Alta., Can., is having plans prepared for a refinery.

Roofing Plant—Building Products, Ltd., 240 St. Patrick St., Montreal, Que., Can., is having plans prepared for a plant on Midland St., Winnipeg, Man.

Rubber Factory — Canadian Mechanical Rubber Corp., Orillia, Ont., Can., is having plans prepared for a factory. Estimated cost $50,000.

Tannery—Dominion Tanners, Ltd., Parr St., Winnipeg, Man., Can., is having plans prepared for a tannery. Estimated cost $40,000.

Tannery—Neponset Tanning Corp., c/o T. E. Hamilton, Archt. & Engr., 421 Marlboro St., Boston, Mass., has had plans prepared for a 2 story, 70x160 ft. tannery on Tinneau St., Dorchester, Mass. Estimated cost $40,000.

Tin Mill—American Consolidated Tin Mines Corp., W. M. Bennett, Vice-Pres. and Director, 120 Liberty St., New York, N. Y., will soon receive bids for the construction of a tin mill in Lincoln County, N. C. Estimated cost $300,000.

Cyanide Mill—Beattie Gold Mines, c/o A. J. Keast, Box 101, Noranda, Que., plans to construct an addition to their new cyanide mill at Duparquet Twp., Que., and will be in the market for new equipment. Cost between $175,000 and $200,000.

Equipment—Department of Agriculture, Forest Service, Madison, Wis., is receiving bids for furnishing a transmission for experimental pulpwood grinder complete with accessories.

Sulphur Plant—Sunland Sulphur Co., Fresno, Calif., is having plans prepared for additions to its sulphur plant including spray plant, fertilizer plant and warehouse. Estimated cost $40,000.

Welding Plant—Superior Welding and Brazing Co., 6538 Russell St., Detroit, Mich., is receiving bids for the construction of a 1 story brazing and welding plant addition to its plant. Pollmar, Ropes & Lindy, 2539 Woodward Ave., Detroit, Mich., are architects. Estimated cost $30,000.

Warehouse—U. S. Gypsum Co., 300 West Adams St., Chicago, Ill., will soon award the contract for the construction of an addition to its warehouse at Greenville, Miss.

CONTRACTS AWARDED

Alkali Mill—Solvay Process Co., Solvay, N. Y., awarded contract for construction work for alkali producing plant at Baton Rouge, La., to United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., for $5,000,000. E. A. Barnes, Chief Purchasing Agent, Solvay, to purchase equipment. Total estimated cost of project $7,000,000.

Brass Factory—Anaconda American Brass, Ltd., 8th St., New Toronto, Ont., Can., awarded contract for 1 story addition to brass factory, to Jos. Wilde & Co., Ltd., 10 Dublin St., Toronto. Estimated cost $75,000.

Chemistry Building—Wellesley College, Wellesley, Mass., awarded contract for physics and chemistry building to J. W. Bishop Co., 109 Foster St., Worcester, Mass. Estimated cost $1,600,000.

Distillery — Mimbres Valley Distillery Co., Deming, N. M., awarded contract for 1 and 4 story distillery to A. C. Colson, c/o Owner. Estimated cost $80,000.

Distillery—Mile High Distillery Co., South Jackson St. and Arkansas Ave., Denver, Colo., awarded contract for distillery to Denver Builders, Inc., 1425 Welton Ave., Denver, Colo. Estimated cost $70,000.

Explosives Plant—Canadian Industries, Ltd., Montreal, Que., Can., awarded contract for plant to Carter, Halls, Aldinger Co., Ltd., Winnipeg, Man. Estimated cost $250,000.

Factory—Imperial Color Works, Inc., Glens Falls, N. Y., awarded contract for addition to factory on Warren St., to Kingsbury Construction Co., 158 Main St., Hudson Falls, N. Y.

Gas Compressor Plant—Southern Natural Gas Co., Monroe, La., awarded contract for gas compressor plant to Ford, Bacon & Davis, 39 Bway., New York, N. Y. Estimated cost $35,000.

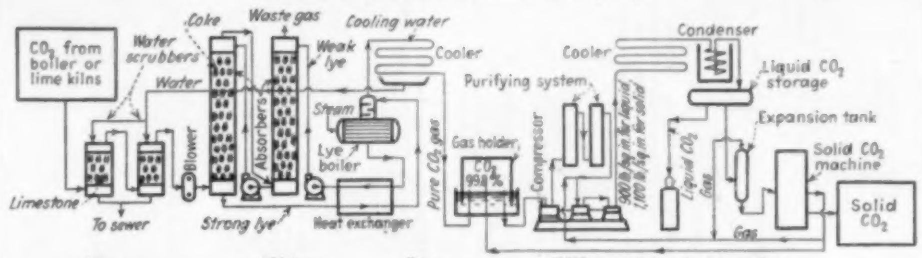
Glue Factory — New England Chemical Industries, Inc., subsidiary of Consolidated Chemical Industries, 500 Fifth Ave., New York, N. Y., awarded contract for flake glue factory on Merrimac St., Woburn, Mass., to Austin Co., 19 Rector St., New York, N. Y. Estimated cost $500,000.

Ore Mill—Lebel Ore Mines, Ltd., Long Lake, Ont., Can., awarded contract for 200 ton cyanide mill to Shoemaker & Burnham. Estimated cost $50,000.

CHEM. & MET. FLOW SHEETS OF PROCESS INDUSTRIES

Continued from *Chem. & Met.*, June, 1934, page 340.

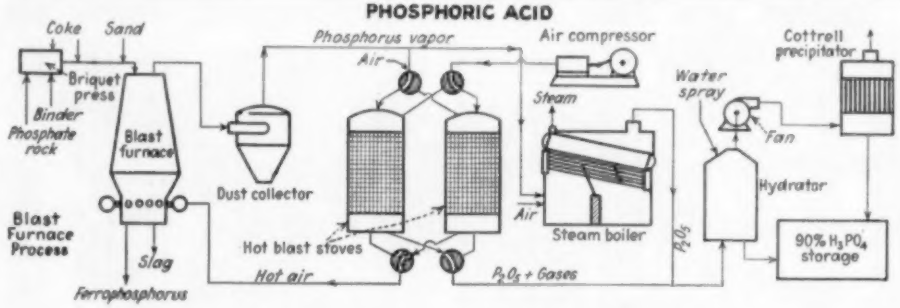
CARBON DIOXIDE (Solid or Liquid)



Coke	=	1.20 tons
Cooling H_2O (total)	=	20,000 gallons
Lye makeup (Na_2CO_3)	=	1,250 pounds
Steam	=	15,000 pounds
Electricity (total)	=	65 kw-hr.
Labor	=	4 man-hr.

Required to produce 1 ton of solid CO_2 from 18 per cent flue gas

PHOSPHORIC ACID

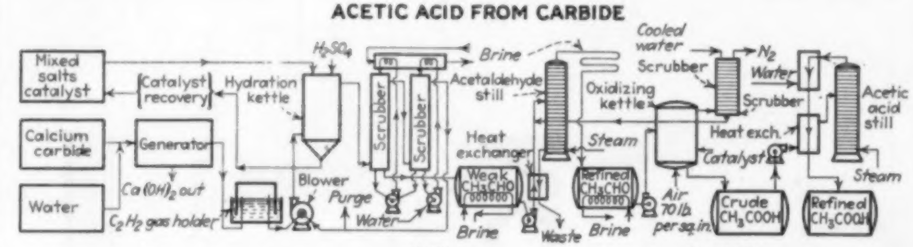


Phosphate rock (27% P_2O_5)	6,000 lb.	Air	450,000	cu.ft.
Silica sand	1,500 lb.	Water (total)	75,000	gal.
Coke	7,000 lb.	Electricity*	4	kw-hr.
Briquet binder	500 lb.	Direct labor	2-4	man-hr.

Per ton 100% H_3PO_4

*For precipitation only; electricity for power depends on waste heat recovery

ACETIC ACID FROM CARBIDE

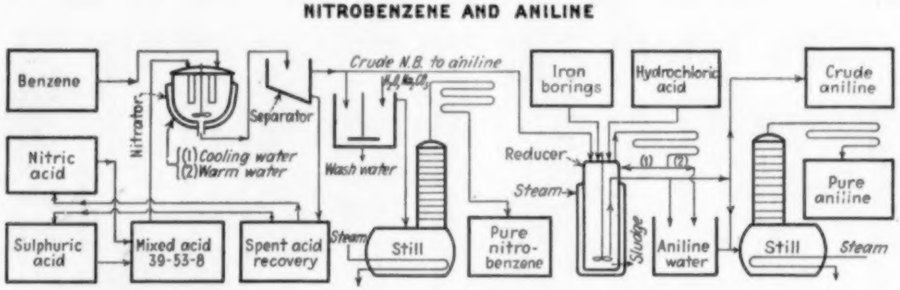


$CaC_2 + H_2O \longrightarrow CH{\equiv}CH + Ca(OH)_2$ $\quad CH{\equiv}CH + H_2O \xrightarrow[\text{Hg salts}]{H_2SO_4} CH_3CHO$ $\quad CH_3CHO + \frac{1}{2}O_2 \xrightarrow{CH_3COOMn} CH_3COOH$

Carbide	4,000 lb.	Electricity (compressed air power and refrigeration)	492 Kw.-hr.
Catalysts	226 lb.	Live steam	7,300 lb.
H_2SO_4	512 lb.	Direct labor	28 man-hr.

Per ton acetic acid

NITROBENZENE AND ANILINE



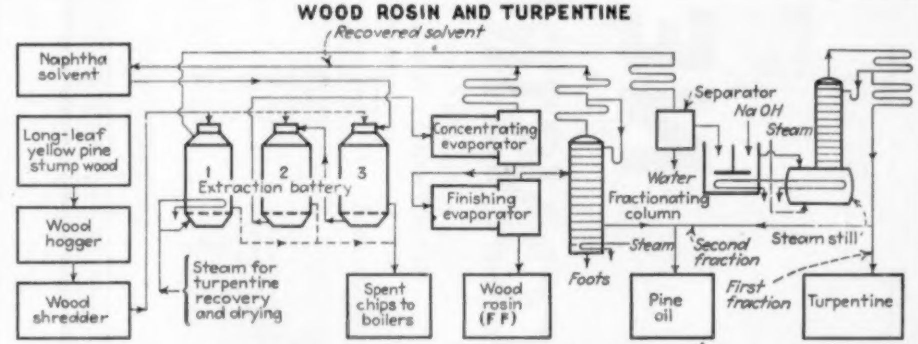
Nitrobenzene

Mixed acid	HNO_3	1,060 lb.	Per ton Nitrobenzene
	H_2SO_4	1,442 lb.	
	H_2O	218 lb.	
Sodium carbonate		20 lb.	
Power (% total cost)		32	
Labor (% total cost)		24	
Overhead (% total cost)		83	

Aniline

Nitrobenzene	2,780 lb.	Per ton Aniline
Iron borings	3,200 lb.	
HCl (30%)	250 lb.	
Power (% total cost)	6.4	
Labor (% total cost)	8.0	
Overhead (% total cost)	4.0	

WOOD ROSIN AND TURPENTINE



Note: Extraction battery is operated as follows: chips are first steamed to recover turpentine and part of the pine oil. Then they are dried, usually in the same extractor, and finally treated with solvent in countercurrent extraction for recovery of wood rosin and remaining pine oil. Above, extractor No.1 is steaming, while Nos. 2 and 3 are shown during solvent treatment.
Average yields per ton of air seasoned wood: 6 gal. of turpentine, 1½ gal. of intermediate terpene hydrocarbons, 4¾ gal. of pine oil and 350 to 400 lb. of "F F" wood rosin